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ELECTRON-PROTON SPECTROMETER (EPS) COMPONENT DERATING SUMMARY

LEC Document Number EPS-878

Prepared by

Lockheed Electronics Company, Inc.
Houston Aerospace Systems Division
Houston, Texas

Under Contract NAS 9-11373

For

National Aeronautics and Space Administration
Manned Spacecraft Center
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Houston Aerospace Systems Division
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ELECTRON-PROTON SPECTROMETER (EPS) COMPONENT DERATING SUMMARY

1.0 INTRODUCTION

1.1 Scope

This document defines the derating factors and analysis of all components used in the Electron-Proton Spectrometer to determine effective system performance. The material presented herein is based on NASA Program Office requirements and may or may not be applicable to other aerospace programs.

1.2 General

This document gives basic information for defining the rating of electrical and electronic components. The derating percentages and application rates assist in obtaining reliable operation of component parts used in manned space mission requirements. (Refer to Appendix A.) Derating is necessary in meeting high reliability standards.

1.3 Applicable Documents

1.3.1 MSC-KA-D-69-44, Revision A, "Apollo Application Program Ancillary Hardware General Requirements."

1.3.2 MIL-HDBK-217A, "Reliability Stress and Failure Rate Data for Electronics Equipment."

1.3.3 MSCM 5320, "Parts Reliability Requirements."

1.4 Derating and Application

The main embodiment of this document presents derating factors and stress rating of component by major subassemblies. Each derating has considered overall system operations and application.

1.5 Abbreviations and Glossary of Terminology Used in Text

1.5.1 Headings

a. RATED - Vendor rating of COMPONENT characteristics.
b. OPERATING - Characteristics under which COMPONENT will be used in the system.
c. EPS DERATING REQUIREMENTS - Required derating of COMPONENT characteristics to meet reliability requirements of the NASA and Skylab programs.

1.5.2 Abbreviations

a. Integrated Circuit Parameters and Loading Definitions

(1) HUL- High Unit Load. The high unit load (HUL) for microcircuits used in the EPS is defined as I = 5 μa.

(2) LUL- Low Unit Load. The low unit load of the microcircuit used in this application is I = 0.16 ma.

(3) Vcc, Vdd - Bias supply voltages

b. Transistor Parameters

(1) VCEO - Maximum rated DC collector to emitter voltage with base lead open.

(2) VCE - Operating DC collector to emitter voltage

(3) VCBO - Maximum rated DC collector to base voltage with emitter lead open.

(4) VCB - Operating DC collector to base voltage

(5) VEBO - Maximum rated reverse DC emitter to base voltage with collector lead open

(6) VEB - Operating DC emitter to base voltage

(7) IC(MAX) - Maximum rated DC collector current at maximum ambient temperature.

(8) IC - Operating DC collector current.

(9) P - Power dissipation of transistor, rated at maximum ambient temperature and operating.

(10) HFE - DC current gain

c. Diode Parameters

(1) IF - DC forward current, rated at maximum ambient temperature and operating.

(2) VR - DC reverse voltage, rated and operating.

(3) P - Power dissipation in diode, rated at maximum ambient temperature and operating.

d. Capacitor Parameters

(1) V - DC working voltage, rated at maximum ambient temperature and operating.

e. Resistor Parameters

(1) P - Power dissipation of resistor, rated at maximum ambient temperature and operating.

(2) V - Average DC voltage across resistor = I (AVG) R

f. Zener Diode Parameters

(1) Vz - Rated zener voltage

(2) P - Power dissipation in diode, rated at maximum ambient temperature and operating.

g. Unijunction Transistor Parameters

(1) V B2 B1 - Interbase voltage, rated and operating.

(2) VEB - Emitter to Base 1 reverse voltage at maximum ambient temperature and operating.

(3) IBB - Interbase current

(4) P - Power dissipation in device, rated at maximum ambient temperature and operating.

h. Transformers and Inductors

(1) Vins. - Core or winding insulation dielectric with standing voltage, rated and operating.

(2) Vpeak - Peak recurrent voltage across winding, rated and operating.

(3) Tw - Winding temperature, rated and operating.

i. Other Parameter Definitions

(1) TA - Ambient temperature

(2) TC - Case temperature

(3) Tj - Junction temperature, semiconductor

j. Subscript and Subnote Definitions

(1) A subscript "D" denotes the derated value of a parameter in accordance with AAP requirements. (i.e. V_{CEOD}, I_{FD} P_D)

j. Continued

(2) A subnote "peak" or "surge" indicates a transient or short term condition with time duration--1 second.

(3) A subnote "max" indicates a maximum rated or operating value.

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ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

INPUT FILTER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Diode TAN TX - 1N4442	CR1 & CR2	V_R = 200V I_F^R = 1000 ma	V_R = 140V I_F^R = 318 ma	V_R = 32V I_F^R = 30 ma
Diode UT4010	CR3 & CR4	V_R = 100V I_F^R = 4000 ma	V_R = 60V I_F^R = 2550 ma	V_R = 32V I_F^R = 550 ma
Diode UT4010	CR5 & CR6	V_R = 100V I_F^R = 4000 ma	V_R = 60V I_F^R = 2550 ma	V_R = 32V I_F^R = 200 ma
Filter 8332-125	FL1, FL2, FL3, FL4	DCV = 100V	DCV = 70V	DCV = 32V
Capacitor T210D156K075PS 15 µf @ 75V	C1	75V	37.5V	32V
C062R104K1X1C .1 µf @ 100V	C2	100V	70 V	"
T210D156K75PS 15 µf @ 75V	C3	75V	37.5V	"
T210D156K75PS 15 µf @ 75V	C4	75V	37.5V	"
T210D156K75PS 15 µf @ 75V	C5	75V	37.5V	"
T210D156K75PS 15 µf @ 75V	C6	75V	37.5V	"
C062R104K1X1C .1 µf @ 100V	C7	100V	70 V	"
Resistors RCR05G4R7JS 4.7Ω	R1	125 mw	62.5 mw	4.2 mw
RCR052R7JS 2.7Ω	R3	125 mw	62.5 mw	0
RWR-81SR500FR 0.5Ω	R2	1 watt	450 mw	152 mw
RWR 815S1R300FR 1.3Ω	R4	1 watt	450 mw	52 mw
Inductor 26 µh	L1	Temp = 180°C Voltage = 500V	150°C 300V	65°C 32V
Inductor 65 µh	L2	Temp = 180°C Voltage = 500V	150°C 300V	65°C 32V

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ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

LOW VOLTAGE POWER SUPPLY

COMPONENT NAME & P/N	DIAGRAM SYMBOL		MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor					
RCR20G392JP	R_{2A}	3.9K	500 mw	250 mw	197.5 mw
RCR20G392JP	R_{2B}	3.9K	500 mw	250 mw	197.5 mw
RCR07G101JP	R_4	100Ω	250 mw	125 mw	1.8 mw
RCR07G100JP	R_5	10Ω	250 mw	125 mw	0.5 mw
RCR07G472JP	R_{14}	4.7K	250 mw	125 mw	83 mw
RCR07G101JP	R_{15}	100Ω	250 mw	125 mw	0 mw
RCR07G470JP	R_{16}	47Ω	250 mw	125 mw	85 mw
RCR07G130JP	R_{21}	13Ω	250 mw	125 mw	11.7 mw
RNC 55	R_1	33.2K	100 mw	50 mw	27.5 mw
RNC 50	R_3	4.75K	50 mw	25 mw	22 mw
"	R_6	39.2K	"	"	6.1 mw
"	R_7	5.62K	"	"	12.3 mw
"	R_8	2.21K	"	"	9.7 mw
"	R_9	2.21K	"	"	9.7 mw
"	R_{10}	18.2K	"	"	4.5 mw
"	R_{11}*		"	"	12.7 mw
"	R_{12}*		"	"	6.6 mw
"	R_{17}	28K	"	"	0.7 mw
"	R_{18}	11.5K	"	"	0.88 mw
"	R_{20}	6.98K	"	"	0.6 mw
"	R_{22}	6.98K	"	"	1.3 mw
"	R_{33}	100K	"	"	5.3 mw
"	R_{34}	10K	"	"	.63 mw
"	R_{38}	10K	"	"	.04 mw
"	R_{39}	15K	"	"	15 mw
3262-1-103	R_{19}	10K Pot	200 mw	100 mw	5 mw

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Capacitor				
C062R332K2X1C	C1 22µf@50V	50V	25V	20V
	C8 22µf@50V	50V	25V	20V
	C2 3300pf@ 200V	200V	140V	17V
	C3 22µf@50V	50V	25V	20V
	C4 4.7@10V	10V	5V	5V
C052R102K2X1C	C5 1000@ 200V	200V	140V	3V
C052R101K2X1C	C6 1000@ 200V	200V	140V	3V
"	C7 47µf@20V	20V	10V	8.1V
"	C9 15@20V	20V	10V	8.1V
"	C10 47@20V	20V	10V	8.1V
"	C11 15@20V	20V	10V	8.1V
"	C12 68@15V	15V	7.5V	5.1V
"	C13 22@15V	15V	7.5V	5.1V
"	C14 68@15V	15V	7.5V	5.1V
"	C15 22@15V	15V	7.5V	5.1V
"	C16 3.9@75V	75V	37.5V	26V
"	C17 3.9@75V	75V	37.5V	26V
"	C18 3.9@75V	75V	37.5V	26V
"	C19 3.9@75V	75V	37.5V	26V
Filter				
8332-125	FL1 thru FL6	100V	70V	30V
8332-126	FL7	100V	70V	5V
8332-125	FL8	100V	70V	30V

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Diode				
UT4010	CR1	V_R 100V I_F 4000 ma	51V 2550 ma	30V 758 ma
JAN-TX 1N914	CR2 & CR3	V_R 75V I_F 75 ma	45V 56 ma	14.4V .5 ma
1N4567A	CR4	V_Z 6.4V I_Z .5 ma P_D 400 mw	- - 160 mw	6.4V .5 ma 3.2 mw
JAN-TX 1N914	CR5 & CR6	V_R 75V I_F 75 ma	45V 56 ma	- 1 ma
JAN-TX 1N746A	CR7	V_Z 3.3V I_Z P_D 400 mw	- .675 amps 100 mw	3.3V .165 amps 0
JAN-TX 1N914	CR8 & CR9	V_R 75V I_F 75 ma	45V 56 ma	40V $\leq$ 50 ma
JAN-TX 1N645	CR10	V_R 275V I_F 400 ma	165V 262 ma	11V .2 ma
UT4010	CR12, CR13 CR14, CR15	V_R 100V I_F 4000 ma	51V 2550 ma	20V 200 ma
UT4010	CR17, CR18 CR19, CR20	V_R 100V I_F 4000 ma	51V 2550 ma	13V 840 ma
JAN-TX 1N645	CR22 & CR23	V_R 275V I_F 400 ma	165V 262 ma	52V 15 ma
JAN-TX 1N758A	CR24	V_Z 10V I_Z 20 ma P_D 400 mw	- - 100 mw	10V 1 ma 10 mw

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Transistor				
JAN-TX 2N2222A	Q1	VCB .75V VCE 40V VEB 6V PD: 500 mw @ 25 Ambient	45V 24V 3.6V 166 mw, T_J=100, T_A=50	<5V .7V .7V .2 mw
JAN-TX 2N3421	Q2	VCB 125V VCE 80V VEB 8V IC 3000 ma PD 1000 mw	75V 48V 4.8V 2.25 amps 286 mw, T_J=100°C T_A=50°C	31.5V 32V .7V 50 ma 10 mw
2N5333	Q3	VCB 100V VCE 80V VEB 6V IC 2000 ma PD 1000 mw	60V 48V 3.6V 1400 ma 286 mw, T_J=100°C T_A=50°C	32V 32V .7V 758 ma 125 mw
JAN-TX 2N494A	Q4	VEB 60V V_{B2-B1} 55V Peak I_E 2 amps PD 600 mw	36V 33V 1.5 amps 200 mw	14.4V 20V 1.4 amps 164 mw
JAN-TX 2N2907A	Q5 & Q6	VCB 60V VCE 40V VEB 5V IC 600 ma PD 400 mw	36V 24V 3V 450 ma 114 mw, T_J=100°C T_A=50°C	14.4V 12V .7V 2 ma 5 mw
JAN-TX 2N2484	Q7	VCB 60V VCE 60V VEB 6V IC 50 ma PD 360 mw	36V 36V 3.6V 37.5 ma 103 mw, T_J=100°C T_A=50°C	5V 5V .7V .5 ma 2.5 mw

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Transistor				
JAN-TX 2N3421	Q8	VCB 125V VCE 80V VEB 8V IC 3000 ma PD 1000 mw	75V 48V 4.8V 2.25 amp 286 mw, T_J=100°C T_A=50°C	20V 20V .7V 200 ma 0 mw
JAN-TX 2N3421	Q9 & Q10	VCB 125V VCE 80V VEB 8V IC 3000 ma PD 1000 mw, T=	75V 48V 4.8V 2.25 amps 286 mw, T_J=100°C T_A=50°C	42.5V 40V 2.5V 550 ma 84 mw
JAN-TX 2N2484	Q11	VCB 60V VCE 60V VEB 6V IC 50 ma PD 360 mw	36V 36V 3.6V 37.5 ma 103 mw, T_J=100°C T_A=50°C	20V 20V .7V 4 ma 2 mw
Amplifier				
A 723	A1	V_+ to V_- 40V in-out Diff 40V V_{REC} Current 15ma PD 800 mw IC 150 ma	- 24V 11.25 ma 340 mw, T_J=100, T_A=50 112 ma	25V 6V .26 ma 105 mw 25 ma
Transformer				
---	T2	Temp 300°C	270°C	81°C
80530-1A	Core	Volt. 1000V	600V	10V
8083	Windings AWG 34 Temperature All	180°C	150°C	81°C
	Voltage - All	1500V	900V	10V

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Inductors				
L1 0.4 mh Wire AWG 24 8078 Core 55121-W4	L1	Temp 180°C Voltage 2850V Temp 200°C Voltage 500V	150°C 1710V 170°C 300V	65°C 32V 70°C 32V
L2 & L3 .75 mh Wire AWG 28 8080 Core 55051-W4	L2 & L3	Temp 180°C Voltage 2400V Temp 200°C Voltage 500V	150°C 1440V 170°C 300V	65°C 10V 70°C 70V
L4 & L5 .06 mh Wire AWG 20 8076 Core 55051-W4	L4 & L5	Temp 180°C Voltage 3450V Temp 200°C Voltage 500V	150°C 2070V 170°C 300V	65°V 6V 70°C 6V
L6 .375 mh Wire AWG 28 8080 Core 55051-W4	L6	Temp 180°C Voltage 2400V Temp 200°C Voltage 500V	150°C 1440 170°C 300V	65°C 6V 70°C 6V
L7 & L8 Wire AWG 36 8084 Core 55040-W4	L7 & L8	Temp 180°C Voltage 1200V Temp 200°C Voltage 500V	150°C 720V 170°C 300V	65°C 26V 70°C 26V

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Transformer				
52134-1A	TI Core	Temp 300°C Voltage 1000V	270°C 600V	81°C 60 Volts
	Windings Temp-All Voltage	Temp 180	150°C	81°C
8078	Primary	Voltage 2850V	1710V	65V
8083	Feedback	Voltage 1500V	900V	32V
8084	Start	Voltage 1200V	720V	36V
8081	8 Volt	Voltage 2100V	1260V	42V
8077	5 Volt	Voltage 3150V	1890V	36V
8084	25 Volt	Voltage 1200V	720V	65V

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ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DETECTOR BIAS SUPPLY

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50	R1 14K	50 mw	25 mw	5 mw
RCR07G130JP	R2 13Ω	250 mw	125 mw	12 mw
RNC50	R3 34.8K	50 mw	25 mw	5 mw
RNC50	R4 22.1K	50 mw	25 mw	2.5 mw
3262W-1-103	R5 10K	200 mw	100 mw	5 mw
RNC50	R6 1K	50 mw	25 mw	10 mw
RN55	R7 13K	100 mw	50 mw	30 mw
MK-132	R8 50K	500 mw	250 mw	1 mw
MG-660	R9 10MΩ	500 mw	250 mw	12 mw
MK-132	R10 100K	500 mw	250 mw	1 mw
MG-660	R11 10MΩ	500 mw	250 mw	1 mw
MG-660	R12 10MΩ	500 mw	250 mw	1 mw
C052R101K2X1C	C1 100pf, 200V	200V	140V	30V
C052R332K2X1C	C2 3300pf, 200V	200V	140V	10V
	C3 18µf, 50V	50V	25V	20V
828-1KV-X5T-103	C4, C5 .01µf C6, C7 1000V	1000V	700V	360V
C052R102K2X1C	C8 1000pf, 200V	200V	140V	3V
C052R102K2X1C	C9 & C10 1000pf 200V	200V	140V	25V
	C11 Selected	200V	140V	50V

DETECTOR BIAS SUPPLY

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Amplifier				
µA723	A1	V_+ to V_- 40V	---	30.8V
		In-Out Diff: 40V	24V	11.3V
		V_{REF} Current 15 ma	11.25 ma	100 µa
		P_D 800 mw	340 mw, T_J=100, T_A=50	196 mw
		I_C 150 ma	112 ma	30 ma
Transistor				
JAN-TX 2N3421	Q1 & Q2	V_{CB} 125V	75V	41.5V
		V_{CE} 80V	48V	40V
		V_{EB} 8V	4.8V	2.5V
		I_C 3000 ma	2250 ma	30 ma
		P_D 1000 mw	286 mw, T_J=100 T_A=50	6 mw
Diode				
JAN-TX 1N914	CR1 & CR2	V_R 75V	45V	39V
		I_F(Surge) 500 ma	375 ma	<50 ma
JAN-TX 1N649	CR3, CR4, CR5 & CR6	V_R 720V	432V	350V
		I_F 400 ma	262 ma	10 ma
JAN-TX 1N649	CR7 & CR8	V_R 720V	432V	350V
		I_F 400 ma	262 ma	10 µa
Transformer				
	TI			
Core 5200 2-1A		Temp 300°C	270°C	65°C
		Voltage 1000V	600V	350V
Windings				
Prim 8085		Temp 180°C	150°C	65°C
		Voltage 1200V	720V	400V
Feedback AWG38 8085		Temp 180°C	150°C	65°C
		Voltage 1200V	720V	360V
Secondary 8085		Temp 180°C	150°C	65°C
		Voltage 720V	432V	360V
Current - All				

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COMPONENT DERATING SUMMARY

PREAMPLIFIER & DETECTOR BIAS FILTER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	E.S.S. DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50	R2	7.87K, 50mw,	25mw	2.2 mw
"	R3	7.15K, "	"	2.1 mw
RNC55	R4	255Ω, 100mw,	50mw	26 mw
RNC50	R5	604Ω, 50mw,	25mw	<1 mw
"	R6	1.21K, 50mw,	25mw	<1 mw
1712-4-100MΩ	R7	100MΩ, 500mw,	250mw	<1 mw
RNC55	R8	2.55K, 100mw,	50mw	25 mw
RNC50	R9,	93.1Ω, 50mw,	25mw	10 mw
"	R10	49.9Ω, "	"	10 mw
"	R1 Select	60.4Ω, 64.9Ω, 69.8Ω, 50mw	"	<10 mw
"	R1 Select	80.6Ω, 90.9Ω, 50mW, 100Ω	"	<10 mw
MK132	R22, R23	100K, 750mw,	375mw	<1 mw
MK132	R24	2.0MΩ, 750mw,	375mw	<1 mw
Capacitor				
RVC-12	C1	.8-25pf, 500V	300V	<8V
RC33C1ROD(NPD)	C2	1.0±.5pf, 50V	30V	<5V
T210	C3	47μF, 6V	3.6V	<1V
T210	C4	3.3μF, 15V	9V	<8V
CKR06	C5, 6, 8	.01μF, 200V	100V	<8V
T210	C7, C9	15μF, 20V	16V	<8V
RC12C	C12 Select	2.9, 3.3, 3.9pf, 50V	30V	<8V
	C13, 14, 15	.01μF, 1000V,	600V	<400V

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ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

PREAMPLIFIER & DETECTOR BIAS FILTER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Coils MS90538-12	L1, L2, L4	100mhy, 220 mw, 133 mA	65 mA, 110mw	<10 mA, <1 mw
526-2930-130	L3	20mhy, 100 mA	50 mA	<10 mA,
Transistor SSC-1613	Q1	V_B=40V, I_C=50mA P_D=360mw	V_B=20V, I_C=25mA P_D=180mw*	<5V, I_C=10mA, 40mw
SS-3515	Q2, Q4	V_B=60V, I_C=200mA P_D=360mw	V_B=30V, I_C=100mA P_D=180mw*	<8V, I_C 3mA, <20mw
SS-3520	Q3	V_B=20V, I_C=50mA, P=300mw	V_B=10V, I_C=25mA, P=368mw*	<8V, I_C=1mA, <10mw
Diode JAN-TX 1N649	CR1	V_{PIV}=720V, 400mA, 600mw	450V, 150mA, 250mw	V_{PIV} <10V, <1mw

*T_J = 100°C T_A = 50°C

LEAKAGE MONITOR

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50H	R11	49.9K, 50mw,	25mw	<1 mw
"	R12	4.99K, "	25mw	<1 mw
MK132	R , R13	2.5MΩ, 750mw,	315mw	<1 mw
MK132	R13	5.0MΩ, "	"	<1 mw
RNC50H	R14	2.67K, 50mw,	25mw	<1 mw
"	R15	80.6K, "	25mw	<1 mw
"	R16	49.9K, "	25mw	<1 mw
3260WM39501	R17	500Ω, 200mw,	100mw	<1 mw
RNC50K	R18	30.1Ω, 50mw,	25mw,	<1 mw
"	R19	30.1Ω, "	" ,	<1 mw
RNC50H	R20	80.0K, "	25mw,	<1 mw
"	R21	267K, "	25mw,	<1 mw
Capacitor				
CKR06	C10	.01μF, 200V	100V	<1V
CKR05	C11	100pf, 200V	100V	<8V
Amplifier				
LM108/883	Z11	V_B=±20V, I=10mA P=500mw	V_S=12V, I=5mA P=330mw	V_S < 8V, I <1mA P <16mw
Diode				
1N4567A	CR2	6.4V, 400mw	6.4V, 160mw	6.4V, 3.8mw,
1N4567A	CR3	" "	" "	" "

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

PULSE AMPLIFIER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
3260HM39	R1	P_D .2W	.1W	41 µW
MK132	R2	.75W	.375W	9.3 µW
RNC50	R3	.05W	25 mW	.08 mW
"	R4	"	"	1.75 mW
"	R5, R29	"	"	292 nW
"	R6	"	"	4.08 nW
"	R7, R31	"	"	.28 mW
"	R8, R33	"	"	292 µW
"	R9, R32	"	"	.44 nW
"	R10, R11	"	"	30.5 µW
"	R12, R36	"	"	295 µW
"	R13, R37	"	"	10.7 µW
"	R14, R38	"	"	4.78 mW
"	R15, R39	"	"	4.08 mW
"	R16, R40	"	"	4.97 mW
"	R17, R41	"	"	565 µW
"	R18, R42	"	"	527 µW
"	R19, R43	"	"	527 µW
"	R20, R44	"	"	2.44 mW
"	R21, R24	"	"	57.5 µM
"	R22, R23	"	"	.23 mW
"	R47, R49	"	"	.216 mW
"	R45, R51	"	"	.054 mW

PULSE AMPLIFIER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50	R25, R52	.05W	25 mW	1.41 mW
"	R26, R46	"	"	1.13 mW
"	R27	"	"	1.38 mW
"	R28	"	"	25.7 nW
"	R34, R35	"	"	.448 mW
"	R48	"	"	.123 mW
"	R50	"	"	25.8 µW
"	R30	"	"	60 µW

PULSE AMPLIFIER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Capacitor				
RC37	C1	50V	35V	7.2V
CSR13	C2, C17	50V	30V	8.06 mV
CKR06	C3, C18	200V	140V	8.06 mV
RC37	C4, C19	50V	35V	2.72V
RC37	C5, C20	50V	35V	2.72V
CSR13	C6, C23	15V	9V	7.9V
CKR06	C7, C24	200V	140V	7.9V
CKR06	C8, C21	100V	70V	1.46 mV
CSR13	C9, C22	15V	9V	7.9V
RC37	C10, C25	50V	35V	7.39V
RC37	C11, C26	50V	35V	3.3V
RC12	C12, C27	50V	35V	1.5V
CKR06	C13, C28	200V	140V	7.9V
RC37	C14, C29	50V	35V	7.55V
RC37	C15, C30	50V	35V	7.9V
RC37	C16	50V	35V	6.6V
CKR06	C31, C32	200V	140V	8.1V

PULSE AMPLIFIER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Diode				
JAN-TX 1N4153	CR1, CR2	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	1 mV I_P 29.7 mA V_P .81V
JAN-TX 1N4153	CR3, CR4 CR12, CR13	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	1 mV I_P 60 mA V_P .7V
JAN-TX 1N4153	CR5, CR18	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	.427 mW I_{DC_0} .7 mA
JAN-TX 1N4153	CR6, CR9 CR14, CR17	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	2.42 mW I_{DC_0} 3.5 mA
JAN-TX 1N4153	CR7, CR8 CR15, CR16	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	0 0 0
JAN-TX 1N4153	CR10, CR11	P_D 500 mW I_F 200 mA V_R 50V	142 mW 150 mA V_P 37.5V	1 mV I_P 8.52 mA V_P .74V

PULSE AMPLIFIER

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Transistor				
2N4878	Q1, Q3	P_D 330 mW I_C 10 mA V_{CEO} 60V V_{EBO} 7V	95 mW * 7.5 mA V_P 45V V_P 5.25V	.44 mW 60 µA V_P 8.4V V_P .18V
2N4878	Q2, Q4	P_D 330 mW I_C 10 mA V_{CEO} 60V V_{EBO} 7V	95 mW * 7.5 mA V_P 45V V_P 5.25V	4.1 mW .4 mA V_P 6.25V V_P .5V
SS2638H	Q5, Q7	P_D 200 mW I_C 30 mA V_{CEO} 20V V_{EBO} 4.5V	57 mW * 22.5 mA V_P 15V V_P 3.37V	24.3 mW 3.5 mA V_P 14.6V V_P 0V
SS2638H	Q6, Q8	P_D 200 mW I_C 30 mA V_{CEO} 20V V_{EBO} 4.5V	57 mW * 22.5 mA V_P 15V V_P 3.37V	11.6 mW 1.5 mA V_P 14.3V V_P 0V
SS3520	Q9, Q11	P_D 200 mW I_C 50 mA V_{CEO} 20V V_{EBO} 3V	57 mW * 37.5 mA V_P 15V V_P 2.25V	22.4 mW 3.5 mA V_P 13.0V V_P 0V
SS3520	Q10, Q12	P_D 200 mW I_C 50 mA V_{CEO} 20V V_{EBO} 3V	57 mW * 37.5 mA V_P 15V V_P 2.25V * T_J = 100°C T_A	11.6 mW 1.5 mA V_P 14.4V V_P .2V = 50°C

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DUAL DIFFERENTIAL PULSE HEIGHT DISCRIMINATOR & RESOLUTION MON

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50H-4531FR	R1	0.05W	0.025W	0.004W
" -3161FR	R2	"	"	0.004W
" -1541FR	R3(C1)	"	"	0.008W
" -1471FR	R3(C2)	"	"	
" -1501FR	R3(C3)	"	"	"
" -1541FR	R3(C4)	"	"	"
" -1541FR	R3(C5)	"	"	"
MK132-500K	R4(C1)	0.50W	0.375W	"
" -440K	R4(C2)	"	"	"
" -480K	R4(C3)	"	"	"
" -550K	R4(C4)	"	"	"
" -590K	R4(C5)	"	"	"
RNC50H-7500FR	R5(C1)	0.050W	0.025W	"
" -7150FR	R5(C2)	"	"	"
" -7870	R5(C3)	"	"	"
" -1001FR	R5(C4)	"	"	"
" -1131FR	R5(C5)	"	"	"
3260HM39201	R6(C1)	0.200V	0.100W	
"	R6(C2)	"	"	"
"	R6(C3)	"	"	"
"	R6(C4)	"	"	"
3260HM39101	R6(C5)	"	"	"
RNC50H-4640FR	R7(C1)	0.050W	0.025W	0.000W
" -6040FR	R7(C2)	"	"	"
" -4870FR	R7(C3)	"	"	"
" -2940FR	R7(C4)	"	"	"
" -2670FR	R7(C5)	"	"	"
" -2101FR	R8(C1)	"	"	"
" - "	R8(C2)	"	"	"
" - "	R8(C3)	"	"	"
" - "	R8(C4)	"	"	"
" -1690FR	R8(C5)	"	"	"

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DUAL DIFFERENTIAL PULSE HEIGHT DISCRIMINATOR & RES. MON.

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
3260HM39500	R9(C1)	0.05W	0.025W	0.014W
"	R9(C2)			
"	R9(C3)			
"	R9(C4)			
3260HM39201	R9(C5)	0.00W	0.00W	0.000W
L0-0HMAGE	R10(C1)	"	"	"
	R10(C2)	"	"	"
	R10(C3)	"	"	"
	R10(C4)	"	"	"
	R10(C5)	"	"	"
RNC50H-1821FR	R11(C1)	0.05W	0.025W	0.000W
" "	R11(C2)	"	"	"
" "	R11(C3)	"	"	"
" "	R11(C4)	"	"	"
" -1781FR	R11(C5)	"	"	"
" -4531FR	R12	"	"	0.014W
" -3161FR	R13	"	"	0.004W
MK132-725K	R14(C1)	0.50W	0.25W	0.000W
" "	R14(C2)	"	"	"
" "	R14(C3)	"	"	"
" "	R14(C4)	"	"	"
" -750K	R14(C5)	"	"	"
RNC50H-1690FR	R15	0.05W	0.025W	0.007W
" "	R16	"	"	"
" -1001FR	R17	"	"	0.009W
" -1000FR	R18	"	"	0.000W
" "	R19	"	"	0.000W

DUAL DIFFERENTIAL PULSE HEIGHT DISCRIMINATOR & RES. MON.

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Inductors				
9210-76 (MS50538-12)	L1	0.599Vdc 0.133A	0.359Vdc 0.043A	0.054Vdc 0.012A
" "	L2	" "	" "	" "
" "	L3	" "	" "	" "
" "	L4	" "	" "	" "
Capacitors				
CKR05BX104KP	C1	100Vdc	70Vdc	5.3Vdc
"	C2	"	"	"
"	C3	"	"	3.5Vdc
"	C4	"	"	"
"	C5	"	"	"
"	C6	"	"	5.3Vdc
"	C7	"	"	"
CKR05BX221KP	C8	200Vdc	140Vdc	5.3Vdc
"	C9	"	"	"

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DUAL DIFFERENTIAL PULSE HEIGHT DISCRIMINATOR & RES. MON.

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Diodes				
JAN-TX 1N914	CR1	V_{Max} = 75 Vdc	45 Vdc	8.2 Vdc
		P_D = .20W	.09W	0.001W
		I_{Ave} .75 ma	56 ma	2 ma
Integrated Circuits				
RA526K	Z1	V_1 = +7.0 Vdc	---	+5.3 Vdc
	Z2	V_2 +7.0 Vdc	---	+5.3 Vdc
		V_{Sup} - 5.0 Vdc	---	-5.3 Vdc
		V_{CM} $\pm$ 5.0 Vdc	$\pm$ 3.0 Vdc	1.0 Vdc
		V_D + 5. Vdc	+3.0 Vdc	+3.0 Vdc
		I_{Out} +100 ma	+75 ma	3.2 ma
SNC5473T-02	Z3	V_1 = 7.0 Vdc	6.2 Vdc	+5.3 Vdc
		V_2 = 4.5 Vdc	4.7 Vdc	+4.7 Vdc
		+0.4 ma	+0.3 ma	+0.2 ma
		I_{Out} - 110 ma	-12 ma	-0.36 ma

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

HEATER CONTROL

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50	R1 13.7K	50 mW	25 mW	3.6 mW
"	R3 19.1K	"	"	.43 mW
"	R4 47.5K	"	"	1.1 mW
"	R5 45.3K	"	"	1.8 mW
"	R6 49.9K	"	"	<1 mW
"	R8 4.99K	"	"	8.7 mW
"	R9 665Ω	"	"	1.2 mW
"	R10 619Ω	"	"	5 mW
"	R11 1.91K	"	"	3.3 mW
"	R12 2.61K	"	"	24.2 mW
"	R13 10.0K	"	"	4.7 mW
"	R14 7.68K	"	"	1 mW
"	R17 4.99K	"	"	.2 mW
"	R18 20K	"	"	.8 mW
RCR07G130JP	R2 13	250 mW	125 mW	30 mW
RCR20G302JP	R15 3.0K	500 mW	250 mW	243 mW
RCR07G104JP	R16 100K	250 mW	125 mW	.005 mW
RCR07G225JP	R19 2.2MΩ	"	"	.17 mW
RCR07G125JP	R20 1.2MΩ	"	"	.1 mW
RCR07G104JP	R21 100K	"	"	.16 mW
Capacitor				
C052R101K2X1C	C1 100pf @ 200V	200V	140V	7V
C052R100K2X1C	C2 10µf @ 75V	75V	37.5V	30V
"	C3 10µf @ 75V	75V	37.5V	30V

HEATER CONTROL

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Transistor				
JAN TX 2N2484	Q1 & Q2	V_{CB} 60V	36V	7V
		V_{CE} 60V	36V	6V
		V_{EB} 6V	3.6V	2V
		I_C 50 ma	37.5 ma	3 ma
		P_D 360 mW	103 mW	1 mW
JAN TX 2N3421	Q3	V_{CD} 125V	75V	[illegible]
		V_{CE} 80V	48V	30V
		V_{EB} 8V	4.8V	1V
		P_D 1 watt	286 mv	1.3 mW
		I_C 3 Amps	2.25 amps	6 ma
JAN TX 2N3421	Q4	V_{CB} 125V	75V	30V
		V_{CE} 80V	48V	30V
		V_{EB} 8V	4.8V	1V
		I_C 3 amps	2.25 amps	100 ma
		I_B 1 amp	.75 amp	5 ma
		P_D 1 watt	286 mW	25 mW
JAN 2N2609	Q5	BV_{GS} 30V	18V	11V
		P_D 300 mW	100 mW	1 mW

HEATER CONTROL

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Amplifier				
µA723	A1	V_+ to V_- 40V	--	30V
		In-Out Diff: 40V	24V	7V
		V_{REF} Current 15 ma	11.25 ma	1 ma
		P_D 800 mW	340 mW	100 mW
		I_C 150 ma	112 ma	5 ma
JAN TX 1N914	CR1	V_R 75V	45V	30V
		I_F 75 ma	56 ma	1 ma
Resistor				
RTH06BS472J	R7	$T_{Operate}$ (Max) 125°C	--	50°C
Heater				
112558-1	H1			

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

TEMPERATURE MONITOR

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50	R2, R9	50mW	25mW	<1mW
3260WM39500	R3, R10	200mW	100mW	<1mW
RNC50	R5, R12	50mW	2.5mW	<1mW
3260WM39501	R6, R13	200mW	100mW	<1mW
RNC50	R7, R14	50mW	25mW	<5mW
MK-132	R1	.75W	375mW	80mW
RNC55	R4	100mW	50mW	30mW
RNC50	R8	50mW	25mW	3.5mW
Diodes				
1N4901A DT710415D	VR1	12.8V, 400mW	12.8V, 160mW	12.8V, 17mW
1N4567A DT710415C	VR2	6.4V, 400mW	6.4V, 160mW	6.4V, 7mW
Transistors				
2N3811	Q1, Q2	500mW, V_{CB}=60V I_C=50ma	75mW,* V_{CB}=80V I_C=5ma	9mW, 8.61, .9ma
			*T_J = 100 T_A	= 50

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (OUTPUT BUFFER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistors				
RCR05 Resistor 1/8W	R1,3,5,7,9, 11,13,15,17, 19,21,23,25	125 mW	62.5 mW	.092 mW
"	R2,4,6,8,10, 12,14,16,18, 20,22,24,26	"	"	8.1 mW
"	R27,28,29	"	"	
"	R30,31,32, 33-R41	"	"	$\leq$.3 mW
"	R42	"	"	$\leq$2.0 mW
"	R43	"	"	$\leq$30 mW
Capacitor				
Elect. Cap.	C1	15 V	10.5	5.3
Ceramic Cap.	C2	100 V	70	5.3

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (OUTPUT BUFFER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN5401	Z1 - All Outputs	7.0 V	16 ma	6.2 V	12 ma	$\leq$5.3 V	11.87 ma
SN54L01	Z2, Pin 14	8.0 V	10 loads	6.8 V	7.5 loads	"	6 loads
"	Z2, Pin 3	"	10 loads I_{Sink}= 2.0 ma	"	"	"	*
"	Z2, Pin 5	"	10 loads I_{Sink}= 2 ma	"	"	"	*
"	Z2, Pin 8	"	10 loads I_{Sink}= 2 ma	"	"	"	*
SN5401	Z3, All Outputs	7.0 V	16 ma	6.2 V	12 ma	"	11.87 ma
SN54L01	Z4, Pin 8, Pin 14	8.0 V	10	6.8 V	7.5	"	*
"	Z4, Pin 5	8.0 V	10	6.8 V	7.5	"	*
SN5401	Z5	7.0 V	16 ma	6.2 V	12 ma	"	11.87 ma

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"

I_{Sink} Derated = 1.5 ma

1 Low Power Load = .18 ma

I_{Sink} Derated Capability =

$$\frac{1.5}{.18} = 8.333 \text{ Low Power Loads}$$

Special Derated Specification for 5401

I_o Input $\leq$ 1.3 ma = $\frac{1.3}{.18}$ =

7.2 Low Power Loads

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN5401	Z1, Pin 14	7.0 V	40	6.2 V	30	$\leq$5.3 V	20
"	Z1, Pin 8	"	"	"	"	"	10
"	Z1, Pin 5	"	"	"	"	"	10
"	Z1, Pin 3	"	"	"	"	"	13
SN54L04	Z2, Pin 2	8.0 V	10	6.8 V	7.5	"	1
"	Z2, Pin 12	"	"	"	"	"	*
"	Z2, Pin 10	"	"	"	"	"	*
"	Z2, Pin 6	"	"	"	"	"	*
"	Z2, Pin 8	"	"	"	"	"	4
"	Z2, Pin 14	"	"	"	"	"	1
SN54L10	Z3, Pin 13	"	"	"	"	"	1
"	Z3, Pin 5	"	"	"	"	"	1
"	Z3, Pin 3	"	"	"	"	"	3
SN54L73	Z4, Pin 9	"	"	"	"	"	4
"	Z4, Pin 8	"	"	"	"	"	1
"	Z4, Pin 12	"	"	"	"	"	3
"	Z4, Pin 13	"	"	"	"	"	1

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"

I_{Sink} Derated = 1.5 ma

1 Low Power Load = .18 ma

I_{Sink} Derated Capability = $\frac{1.5}{.18}$ = 8.333 Low Power Loads

Special Derated Specification for 5401

I_o Input $\leq$ 1.3 ma = $\frac{1.3}{.18}$ = 7.2 Low Power Loads

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L00	Z5, Pin 5	8 V	10	6.8 V	7.5	≤5.3 V	2
"	Z5, Pin 8	"	"	"	"	"	1
"	Z5, Pin 3	"	"	"	"	"	1
Not used	Z5, Pin 14						
96L02	Z6, Pin 7	7 V	12	6.2 V	9	"	1
Not used							
SN54L20	Z7, Pin 10	8 V	10	6.8 V	7.5	"	1
"	Z7, Pin 2	"	"	"	"	"	1
"	Z8, Pin 10	"	"	"	"	"	1
"	Z8, Pin 2	"	"	"	"	"	1
"	Z9, Pin 10	"	"	"	"	"	4
"	Z9, Pin 2	"	"	"	"	"	1
"	Z10, Pin 10	"	"	"	"	"	4
"	Z10, Pin 2	"	"	"	"	"	1
"	Z11, Pin 10	"	"	"	"	"	1
"	Z11, Pin 2	"	"	"	"	"	1
"	Z12, Pin 10	"	"	"	"	"	1
"	Z12, Pin 2	"	"	"	"	"	1
"	Z13, Pin 10	"	"	"	"	"	2
"	Z13, Pin 2	"	"	"	"	"	1

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L04	Z14, Pin 10	8.0 V	10	6.8 V	7.5	≤5.3 V	4
"	Z14, Pin 12	"	"	"	"	"	4
"	Z14, Pin 6	"	"	"	"	"	3
"	Z14, Pin 8	"	"	"	"	"	6
"	Z14, Pin 14	"	"	"	"	"	1
"	Z14, Pin 2	"	"	"	"	"	4
SN54L00	Z15, Pin 14	"	"	"	"	"	1
"	Z15, Pin 5	"	"	"	"	"	2
"	Z15, Pin 3	"	"	"	"	"	3
		"	"	"	"	"	2
SN54L73	Z16, Pin 12	"	"	"	"	"	3
"	Z16, Pin 13	"	"	"	"	"	2
"	Z16, Pin 9	"	"	"	"	"	7
"	Z16, Pin 8	"	"	"	"	"	1
"	Z17, Pin 12	"	"	"	"	"	1
"	Z17, Pin 13	"	"	"	"	"	1
"	Z17, Pin 9	"	"	"	"	"	1
"	Z17, Pin 8	"	"	"	"	"	1

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L04	Z18, Pin 2	8 V	10	6.8 V	7.5	≤5.3 V	3
"	Z18, Pin 10	"	"	"	"	"	4
"	Z18, Pin 14	"	"	"	"	"	4
"	Z18, Pin 8	"	"	"	"	"	1
"	Z18, Pin 6	"	"	"	"	"	1
"	Z18, Pin 12	"	"	"	"	"	1
SN54L00	Z19, Pin 5	"	"	"	"	"	3
"	Z19, Pin 3	"	"	"	"	"	4
"	Z19, Pin 14	"	"	"	"	"	2
"	Z19, Pin 8	"	"	"	"	"	
SN54L73	Z20, Pin 12	"	"	"	"	"	5
"	Z20, Pin 13	"	"	"	"	"	5
"	Z20, Pin 9	"	"	"	"	"	6
"	Z20, Pin 8	"	"	"	"	"	4
SN54L04	Z21, Pin 14	"	"	"	"	"	7
"	Z21, Pin 6	"	"	"	"	"	4
"	Z21, Pin 10	"	"	"	"	"	6
		"	"	"	"	"	4

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L73	Z22, Pin 9	8.0 V	10	6.8 V	7.5	≤5.3 V	3
"	Z22, Pin 8	"	"	"	"	"	3
		"	"	"	"	"	N/A
		"	"	"	"	"	N/A
SN54L00	Z22, Pin 8	"	"	"	"	"	6
"	Z23, Pin 14	"	"	"	"	"	2
"	Z23, Pin 5	"	"	"	"	"	2
		"	"	"	"	"	
SN54L10	Z24, Pin 3	"	"	"	"	"	1
"	Z24, Pin 13	"	"	"	"	"	1
"	Z24, Pin 5	"	"	"	"	"	2
SN54L10	Z25, Pin 13	"	"	"	"	"	2
"		"	"	"	"	"	
"		"	"	"	"	"	
96L02	Z26, Pin 7	7.0 V	12	6.2 V	9	"	1
"	Z26, Pin 9	"	"	"	9	"	1
LM111	Z27	36 V		21.6 V		"	

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (SEQUENCER CONTROL & LINE REC.)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Diode		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
HP5082-2827	CR1	PRV=19V I_F=55ma	700 mW	11.5 I_F = 41	315 mW	1.7 V I_F = .54	.108 mW
Resistor							
Resistor 22K	R1, R14, R16	--	125 mW	--	62.5 mW	--	≤.25 mW
Resistor 1K	R2, R15, R17	--	"	--	"	--	≤5 mW
Resistor 1K	R3, R18, R19	--	"	--	"	--	"
Resistor 10K	R5, R6, R7	--	"	--	"	--	≤.5 mW
Resistor 100Ω	R8	--	"	--	"	--	50 mW
Resistor 10.5K	R9	--	50	--	25 mW	--	.5 mW
Resistor 51.1K	R10	--	50	--	"	--	25 mW
Resistor 64K	R11	--	50	--	"	--	2.0 mW
Resistor 2.94K	R12	--	50	--	"	--	.75 mW
Resistor 1K	R13	--	125 mW	--	62.5 mW	--	12.5 mW
Resistor 10K	R20	--	125 mW	--	62.5 mW	--	≤2.5 mW
Resistor 1K	R21	--	125 mW	--	62.5 mW	--	10 µW
Capacitors							
Ceramic 100Pf	C1, C2, C3	50 V		35 V		≤5.3 V	
Ceramic .1 µf	C4	100 V		70 V		"	
Elect 3.3 µf	C5	15 V		10.5 V		"	

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (A/D CONVERTER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
MG660	R2	600 mW	300 mW	2.5 µW
RNC50 4.99K	R3	50 mW	25 mW	0
RNC50 11.3K	R4	"	"	0
RNC50 9.53K	R5	"	"	2.5 µW
RNC50 47.5K	R6	"	"	.1 mW
Pot. 3260H 10K	R7	200 mW	100 mW	.09 mW
RNC50 Selected	R8	50 mW	25 mW	.9 mW
RNC50 4.99K	R9	"	"	5 mW
MG660 10M	R10	600 mW	300 mW	2.5 µW
RNC50 49.9K	R11	50 mW	25 mW	.2 mW
RNC50 49.9K	R12	"	"	.2 mW
RNC50 49.9K	R13	"	"	.2 mW
RNC50 4.99K	R14	"	"	5 mW
Capacitor				
Ceramic .1 µf	C3, 4, 6, 7 9, 10, 11, 13, 14	100 V	70 V	8 V
Ceramic 100Pf	C5, 8, 16	50 V	35 V	8 V
Ceramic .01 µf	C12	100 V	70 V	8 V
Polycarbonate 2 µf	C15	50 V	35 V	5 V
Zener Diode				
1N4567A Zener	VR1	400mW @ 3.2mW/°C 336mW @ 70°C 52 ma	39 ma 250 mW	3.4 mW .5 ma

DATA PROCESSOR (A/D CONVERTER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Integrated Circuits				Actual Voltage / Actual Loading
LM108		Rated Voltage	Derated Voltage	
	Z3, Z1, Z2	Supply Voltage ±20 V	±12 V	±8 V / ± 8 V 5 V max. 6.4 mW
	Diff. Input Volt Limited to Supply V. ± 8			
	Power Dissipation 500 mW (150°C/W)			
	I_{out} - Device is short - Circuit protected			
LM111	Z4	Supply V 36 V. Total	21.6 V	+8 V
	Diff. Input Voltage ±30 V [Clamped (+) and (-) with Diodes]			
	Power Dissipation 500 mW (150°C/W)			
DAS2132	Z5	Supply V. ±18 V -V cannot be derated for proper operation	+10.8 V	+8.0 V -15.0 V
	Current switched is $\leq$ .1 ma, which is 1/10 of manufacturers test current.			
	Voltage switched is $\leq$ 5 volts, which is 1/2 manufacturers test voltage.			

DATA PROCESSOR (A/D CONVERTER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Diode				
1N914	CR1, CR2	PRV 75 V 250 mW	45 V 175 mW	5 V .01 mW
		I_F = 100 ma I_{FD}	= 50	Actual $\leq$ 1 ma

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (A/D CONTROL)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L01	Z1, Pin 14	8.0 V	10	6.8 V	7.5	$\leq$5.3 V	*
"	Z1, Pin 8	"	"	"	"	"	*
"	Z1, Pin 5	"	"	"	"	"	*
"	Z1, Pin 3	"	"	"	"	"	*
SN54L93	Z2, Pin 13	"	"	"	"	"	7
"	Z2, Pin 9	"	"	"	"	"	5
"	Z2, Pin 10	"	"	"	"	"	5
"	Z2, Pin 12	"	"	"	"	"	5
SN54L00	Z2, Pin 3	"	"	"	"	"	1
"	Z3, Pin 5	"	"	"	"	"	6
"	Z3, Pin 8	"	"	"	"	"	2
"	Z3, Pin 14	"	"	"	"	"	2
SN54L73	Z4, Pin 12	"	"	"	"	"	4
"	Z4, Pin 9	"	"	"	"	"	5
96L02	Z5, Pin 9	7.0 V	12	6.2 V	9	"	3
SN54L01	Z6, Pin 14	8.0 V	10	6.8 V	7.5	"	*
"	Z6, Pin 8	"	"	"	"	"	*
"	Z6, Pin 5	"	"	"	"	"	*
"	Z6, Pin 3	"	"	"	"	"	*

*The load is a special SN5401 chosen to be driven by Low-Power device

I_{Sink} = 2 ma for "O"

I_{Sink} Derated = 1.5 ma

1 Low Power Load = 1.8 ma

I_{Sink} Derated Capability = $\frac{1.5}{.18}$ = 8.333 Low Power Loads

Special Derated Specification for 5401

I_o Input $\leq$ 1.3 ma = $\frac{1.3}{.18}$ = 7.2 Low Power Loads

DATA PROCESSOR (A/D CONTROL)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L93	Z7, Pin 13	8.0 V	10	6.8 V	7.5	≤5.3 V	4
"	Z7, Pin 9	"	"	"	"	"	2
"	Z7, Pin 10	"	"	"	"	"	2
"	Z7, Pin 12	"	"	"	"	"	4
SN54L01	Z8, Pin 14	"	"	"	"	"	*
"	Z8, Pin 8	"	"	"	"	"	*
"	Z8, Pin 5	"	"	"	"	"	*
"	Z8, Pin 3	"	"	"	"	"	*
SN54L93	Z9, Pin 13	"	"	"	"	"	4
"	Z9, Pin 9	"	"	"	"	"	2
"	Z9, Pin 10	"	"	"	"	"	2
"	Z9, Pin 12	"	"	"	"	"	4
SN54L30	Z10, Pin 12	"	"	"	"	"	1
SN54L20	Z11, Pin 2	"	"	"	"	"	1
SN54L04	Z12, Pin 10	"	"	"	"	"	1
"	Z12, Pin 8	"	"	"	"	"	3
"	Z12, Pin 12	"	"	"	"	"	1
"	Z12, Pin 14	"	"	"	"	"	1
"	Z12, Pin 6	"	"	"	"	"	2
"	Z12, Pin 2	"	"	"	"	"	5

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"

I_{Sink} Derated = 1.5 ma

1 Low Power Load = .18 ma

I_{Sink} Derated Capability = $\frac{1.5}{.18}$ = 8.333 Low Power Loads

Special Derated Specification for 5401

I_O Input ≤ 1.3 ma = $\frac{1.3}{.18}$ = 7.2 Low Power Loads

DATA PROCESSOR (A/D CONTROL)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L00	Z13, Pin 3	8.0 V	10	6.8 V	7.5	$\leq$5.3 V	2
"	Z13, Pin 5	"	"	"	"	"	1
"	Z13, Pin 14	"	"	"	"	"	1
"	Z13, Pin 8	"	"	"	"	"	1
SN54L73	Z14, Pin 12	"	"	"	"	"	4
"	Z14, Pin 9	"	"	"	"	"	1
"	Z14, Pin 8	"	"	"	"	"	1
SN54L00	Z15, Pin 5	"	"	"	"	"	4
"	Z15, Pin 3	"	"	"	"	"	6
"	Z15, Pin 8	"	"	"	"	"	1
SN54L01	Z16, Pin 3	"	"	"	"	"	
SN54L01	Z16, Pin 14	"	"	"	"	"	
Resistors							
Resistor 22K	R1	125 mW		62.5 mW		.25 mW	
Resistor 1K	R2	"		"		$\leq$5 mW	
Resistor 10K	R3	"		"		$\leq$2.5 mW	
Resistor 1K	R4	"		"		$\leq$.5 mW	
Capacitors							
Ceramic 100 Pf	C1	50 V		35 V		$\leq$5.3 V	
Ceramic .1 µf	C2	100 V		70 V		"	
Elect 3.3 µf	C3	15 V		10.5 V		"	

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"
I_{Sink} Derated = 1.5 ma
1 Low Power Load = .18 ma
I_{Sink} Derated Capability =

$$\frac{1.5}{.18} = 8.333 \text{ Low Power Loads}$$

Special Derated Specification for 5401

I_o Input $\leq$ 1.3 ma = $\frac{1.3}{.18}$ =

7.2 Low Power Loads

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (COUNTER MEMORY)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loadings	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L04	Z1, Pin 12	8.0 V	1.0	6.8 V	7.5	≤5.3 V	6
"	Z1, Pin 10	"	"	"	"	"	6
"	Z1, Pin 2	"	"	"	"	"	6
"	Z1, Pin 6	"	"	"	"	"	6
"	Z1, Pin 8	"	"	"	"	"	1
"	Z1, Pin 14	"	"	"	"	"	6
SN54L93	Z2, Pin 13	"	"	"	"	"	3
"	Z2, Pin 9	"	"	"	"	"	1
"	Z2, Pin 10	"	"	"	"	"	1
"	Z2, Pin 12	"	"	"	"	"	3
"	Z5, Pin 13	"	"	"	"	"	3
"	Z5, Pin 9	"	"	"	"	"	1
"	Z5, Pin 10	"	"	"	"	"	1
"	Z5, Pin 12	"	"	"	"	"	3
"	Z6, Pin 13	"	"	"	"	"	3
"	Z6, Pin 9	"	"	"	"	"	1
"	Z6, Pin 10	"	"	"	"	"	1
"	Z6, Pin 12	"	"	"	"	"	3

DATA PROCESSOR (COUNTER MEMORY)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L93	Z9, Pin 13	8.0 V	10	6.8 V	7.5	≤5.3 V	3
"	Z9, Pin 9	"	"	"	"	"	1
"	Z9, Pin 10	"	"	"	"	"	1
"	Z9, Pin 12	"	"	"	"	"	3
"	Z10, Pin 13	"	"	"	"	"	3
"	Z10, Pin 9	"	"	"	"	"	1
"	Z10, Pin 10	"	"	"	"	"	1
"	Z10, Pin 12	"	"	"	"	"	3
"	Z13, Pin 13	"	"	"	"	"	3
"	Z13, Pin 9	"	"	"	"	"	1
"	Z13, Pin 10	"	"	"	"	"	1
"	Z13, Pin 12	"	"	"	"	"	1
SN54L95	Z3, Pin 9	"	"	"	"	"	1
"	Z4, Pin 9	"	"	"	"	"	1
"	Z7, Pin 9	"	"	"	"	"	1
"	Z8, Pin 9	"	"	"	"	"	1
"	Z11, Pin 9	"	"	"	"	"	1
"	Z12, Pin 9	"	"	"	"	"	2

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (COUNTER MEMORY)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuit		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L01	Z14, Pin 8	8.0 V	10	6.8 V	7.5	≤5.3 V	2
"	Z14, Pin 3	"	"	"	"	"	2
Resistor							
RNC50 4.99K	R1	50 mW		25 mW		5 mW	
RCR05 1.0K	R2	125 mW		62.5 mW		.36 mW	
Capacitor							
.1µf Ceramic	C1	100 V		70 V		≤5.3 V	
33µf Elect	C2	15 V		10.5 V		≤5.3 V	

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (MONITOR MODULE)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistor				
RNC50 Resistor 10.0K	R2	50 Mw	25 mW	2.5 mW
22.1K	R3	"	"	5.8 mW
21.5K	R4	"	"	1.2 mW
78.7K	R5	"	"	4 mW
100K	R6	"	"	2.5 mW
6.2K	R7	"	"	4 mW
4.99K	R8	"	"	.06 mW
24.9K	R9	"	"	.25 mW
8.66K	R10	"	"	1.8 mW
8.66K	R11	"	"	1.8 mW
5.11K	R12	"	"	1.2 mW
5.11K	R13	"	"	1.2 mW
100K	R14	"	"	5.3 mW
10.0K	R15	"	"	.53 mW
Diode				
JAN TX 1N914	CR1	PRV 75V 250mW	PRV 45V 175mW VF @100ma 1.25ma	PRV 8V 0 for VF=.01 normal
JAN TX 1N914	CR2	PRV 75V 250mW	45V 175mW	8V <15 μW
JAN TX 1N914	CR3	PRV 75V 250mW	45V 175mW	8V <15 μW

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ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (MULTIPLEXER)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Multiplexer				
		Rated Voltage		Actual Voltage
HS-1000	Z1 $+V_{CC}$	--		$\leq$5.3
"	$-V_{EE}$	-15		-8.0
"	Analog Input	±10 V	0	0 +5V
Resistor				
RNC50 1K	R1	50 mW	25 mW	$\leq$25 mW
Inductor				
				.65 mW
90538-12	L1	133 ma	93 ma	12 ma
Miller	L2	220 mW 133 ma	12 mW 93 ma	3.5 mW 28 ma
Ceramic .1µf	C1	100 V	70 V	$\leq$5.3 V
" "	C2	100 V	70 V	$\leq$8.3 V

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (DATA COMPRESSOR)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
96L02	Z1, Pin 10, Pin 6		12 Loads		8.4		1
SN54L73	Z2, Pin 12	8.0 V	10	6.8 V	7.5	≤5.3 V	4
"	Z2, Pin 13	"	"	"	"	"	4
"	Z2, Pin 9	"	"	"	"	"	4
SN54L04	Z3, Pin 14	"	"	"	"	"	1
"	Z3, Pin 2	"	"	"	"	"	7
"	Z3, Pin 6	"	"	"	"	"	7
"	Z3, Pin 8	"	"	"	"	"	1
"	Z3, Pin 12	"	"	"	"	"	2
SN54L73	Z4, Pin 12	"	"	"	"	"	2
"	Z4, Pin 13	"	"	"	"	"	1
"	Z4, Pin 9	"	"	"	"	"	2
"	Z4, Pin 8	"	"	"	"	"	1
"	Z5, Pin 12	"	"	"	"	"	2
"	Z5, Pin 13	"	"	"	"	"	1
"	Z5, Pin 9	"	"	"	"	"	2
"	Z5, Pin 8	"	"	"	"	"	1

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L73	Z6, Pin 12	8.0 V	10	6.8 V	7.5	$\leq$5.3 V	2
"	Z6, Pin 13	"	"	"	"	"	1
"	Z6, Pin 9	"	"	"	"	"	2
"	Z6, Pin 8	"	"	"	"	"	1
"	Z7, Pin 12	"	"	"	"	"	1
"	Z7, Pin 13	"	"	"	"	"	1
"	Z7, Pin 9	"	"	"	"	"	2
"	Z7, Pin 8	"	"	"	"	"	0
SN54L01	Z8, Pin 5	"	"	"	"	"	*
"	Z8, Pin 8	"	"	"	"	"	*
"	Z8, Pin 14	"	"	"	"	"	*
"	Z8, Pin 3	"	"	"	"	"	*
"	Z9, Pin 3	"	"	"	"	"	*
"	Z9, Pin 5	"	"	"	"	"	*
"	Z9, Pin 8	"	"	"	"	"	*
"	Z9, Pin 14	"	"	"	"	"	*
SN54L93	Z10, Pin 9	"	"	"	"	"	1
"	Z10, Pin 13	"	"	"	"	"	2
"	Z10, Pin 10	"	"	"	"	"	1
"	Z10, Pin 12	"	"	"	"	"	1

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"

I_{Sink} Derated = 1.5 ma

1 Low Power Load = .18 ma

I_{Sink} Derated Capability = $\frac{1.5}{.18}$ = 8.333 Low Power Loads

Special Derated Specification for 5401

I_O Input $\leq$ 3 ma = $\frac{1.3}{.18}$

7.2 Low Power Loads

DATA PROCESSOR (DATA COMPRESSOR)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Voltage	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L01	Z11, Pin 3	8.0 V	10	6.8 V	7.5	$\leq$5.3 V	*
"	Z11, Pin 14	"	"	"	"	"	*
"	Z11, Pin 5	"	"	"	"	"	*
"	Z11, Pin 8	"	"	"	"	"	*
SN5401	Z12, Pin 5	7.0 V	40	6.2 V	30	"	I_{Sink}= 11.87
"	Z12, Pin 3	"	"	"	"	"	17
"	Z12, Pin 8	"	"	"	"	"	16
"	Z12, Pin 14	"	"	"	"	"	10
SN54L00	Z13, Pin 3	8.0 V	10	6.8 V	7.5	"	1
"	Z13, Pin 14	"	"	"	"	"	6
"	Z13, Pin 8	"	"	"	"	"	2
"	Z13, Pin 5	"	"	"	"	"	1 (Standard Load)
SN54L73	Z14, Pin 12	"	"	"	"	"	4
"	Z14, Pin 9	"	"	"	"	"	2
"	Z14, Pin 8	"	"	"	"	"	2
"	Z15, Pin 9	"	"	"	"	"	2
"	Z15, Pin 8	"	"	"	"	"	2
"	Z15, Pin 12	"	"	"	"	"	3
"	Z15, Pin 13	"	"	"	"	"	1

*The load is a special SN5401 chosen to be driven by Lo-Power device

I_{Sink} = 2 ma for "0"
I_{Sink} Derated = 1.5 ma
1 Low Power Load = .18 ma
I_{Sink} Derated Capability = $\frac{1.5}{.18}$ = 8.333 Low Power Loads

Special Derated specification for 5401
I_O Input $\leq$ 1.3 ma = $\frac{1.3}{.18}$ = 7.2 Low Power Loads

LOCKHEED ELECTRONICS COMPANY
HOUSTON AEROSPACE SYSTEMS COMPANY

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (DATA COMPRESSOR)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING		EPS DERATING REQUIREMENT		ACTUAL OPERATING LEVEL	
Integrated Circuits		Rated Voltage	Rated Loading	Derated Voltage	Derated Loading	Actual Voltage	Actual Loading
SN54L73	Z16, Pin 12	8.0 V	10	6.8 V	7.5	≤5.3 V	1
"	Z16, Pin 13	"	"	"	"	"	1
SN54L30	Z17, Pin 12	"	"	"	"	"	5
"	Z18, Pin 12	"	"	"	"	"	3
SN54L00	Z19, Pin 5	"	"	"	"	"	2
"	Z19, Pin 3	"	"	"	"	"	1
"	Z19, Pin 14	"	"	"	"	"	1
"	Z19, Pin 8	"	"	"	"	"	2
"	Z20, Pin 3	"	"	"	"	"	1 (Standard Power Load)
"	Z20, Pin 5	"	"	"	"	"	1
"	Z20, Pin 14	"	"	"	"	"	3
SN54L04	Z21, Pin 14	"	"	"	"	"	1 (Standard Power Load)
"	Z21, Pin 2	"	"	"	"	"	1
"	Z21, Pin 10	"	"	"	"	"	1
"	Z21, Pin 6	"	"	"	"	"	1 (Standard Power Load)
"	Z21, Pin 8	"	"	"	"	"	6

ELECTRON-PROTON SPECTROMETER
COMPONENT DERATING SUMMARY

DATA PROCESSOR (DATA COMPRESSOR)

COMPONENT NAME & P/N	DIAGRAM SYMBOL	MANUFACTURERS RATING	EPS DERATING REQUIREMENT	ACTUAL OPERATING LEVEL
Resistors				
		Rated Loading	Derated Loading	Actual Loading
RNC50 Resistor	R1	50 mW	25 mW	5.19 mW
RNC50	R2, R3	50 mW	25 mW	20.4 mW
RNC50	R4	50 mW	25 mW	.653 mW
RNC50	R5	50 mW	25 mW	2.6 mW
22K	R9, R6, R11 R13	125 mW	62.5 mW	1.3 mW
1K	R7, R10, R12, R14	125 mW	62.5 mW	3.6 µW
1K	R8, R16, R17, R15, R25, R19, R18, R24	125 mW	62.5 mW	<5 mW
18K	R23	50 mW	25 mW	<.3 mW
10K	R21, R22, R20	125 mW	62.5 mW	<.5 mW
Capacitors				
Ceramic Cap.	C1	50 V	35 V	≤5.3 V
Ceramic Cap. 100 Pf	C2, C3, C4, C5	50 V	35 V	"
Ceramic Cap. .01µf	C6	100 V	70 V	"
Elect	C7	15 V	10.5 V	"
Transistor				
JAN TX 2N2222	Q1	V_{CEO}=40V	24V	≤10.6V
		V_{CB}=75V 500mW	45V 245mW	≤10.6V 2.5 mW
		V_{EB} = 6V	3.6V	≤2.8V
JAN TX 2N2222	Q2	V_{CEO}=40	24V	≤10.6V
		V_{CB}=75 500mW	45V 245mW	≤10.6V 2.5 mW
		V_{EB}=6	3.6V	

APPENDIX

DERATING GUIDELINES FOR EEE PARTS, EPS EXPERIMENT

1.0 Introduction

These guidelines give basic information for defining the rating of electrical, electronic and electromechanical parts. The derating percentages and application notes will assist the designer in obtaining reliable operation of component parts used in manned space mission requirements. This document shall be used to the extent specified in the contract.

2.0 Purpose

Derating is a technique whereby a part is selected to have a manufacturer's rating well in excess of the stress values that the part will actually experience. By decreasing mechanical, thermal and electrical stresses, the possibility of degradation or catastrophic failure is lessened.

3.0 Resistor Derating

3.1 Derating Factors

The resistor derating factors shown in Table 3.1 will require the application of the principles shown in the following sections. In all cases the derated percentages do not include the known or allowed changes due to temperature or frequency. The applicable percentages or ratios should be applied to the characteristics or ratings taking into consideration the temperature or frequency of actual operation.

3.2 Precautions

3.2.1 Power Deratings

The objective of power deratings is to establish the worst case hot spot temperature for the resistor. The power in a resistor causes the temperature to rise above ambient temperature by an amount directly related to the amount of power dissipated. The maximum power can vary due to maximum voltage limitation.

Table 3-1

RESISTOR DERATING

Resistor Type (Fixed, unless otherwise noted)	Maximum Permissible Percentage of Manufacturer's Stress Rating		
	Rated Power (See Note 2)	Voltage (See Note 1)	Current
Composition	50	80	75
Film, High Stability	50	80	75
Film, Gen'l Purpose	50	80	75
Wirewound Accurate	50	80	75
Wirewound Power	50	80	75
Thermistor	50	80	75
Variable, all		80	75 (See Note 3)

NOTES:

1. Voltage applied should be no more than $\sqrt{RP}$, where P is the derated maximum power, but in no case should the voltage exceed 80% of the published rating as shown in this table.

2. The derating percentage is applied after the permissible power is determined from the manufacturer's rating when all conditions and recommendations are observed. Rated power figure shown is based on resistors being mounted separately. Multiply rated power by 0.8 when resistors are mounted in close proximity.

3. Current in variable resistors is as designated for any portion of the winding.

3.2.1 (continued)

Computations of derated power apply to the maximum power permissible under conditions of voltage or ambient pressure. The derating percentage is applied after the permissible power is determined from the manufacturer's rating when all conditions and recommendations are observed.

3.2.1.1 The thermal conductivity implied by the listed derating is based on the following assumptions:

a. The resistor is mounted in air at normal atmospheric pressures.

b. Air is free to circulate by normal convection.

c. The device is attached by its leads to an infinite heat sink placed at the rated distance from the body.

d. The ability of a resistor to dissipate heat will be decreased by:

1. longer leads

2. restricted air circulation

3. radiant heat reflected from adjacent areas

4. reduced air pressures.

e. The ability of a resistor to dissipate heat will be increased by:

1. shorter leads

2. increased air circulation

3. surrounding the resistor with an encapsulating having a thermal conductivity superior to air.

3.2.1.2 Chassis mounted resistors are designed to conduct most of the heat through the chassis. The rated power assumes the connection is made to an infinite heat sink. Power ratings require reduction in accordance with the thermal resistivity of the mounting surface and its temperature.

3.2.2 Voltage Derating

The voltage shall be derated to a percentage of the maximum allowable voltage as determined from the manufacturers rating. This voltage may be limited by derated power as well as the maximum voltage of the resistor. The derated voltage shall be the smaller of the two voltages.

$$V_d = C_v V_r$$

$$V_d = \sqrt{P_d R}$$

where:

V_d = derated voltage

P_d = derated power

C_v = derating constant= percentage derating/100

V_r = rated voltage

R = resistance value

3.2.3 Maximum Hot Spot Temperature

The maximum hot spot temperature of a resistor is defined as the highest temperature of any point on the resistor due to any combination of ambient temperature rise due to heating.

3.2.4 Inductance Effects

All resistors have inductance which varies from very small values for some film types. This effect increases as the number of forms required to spiral a resistor and is normally maximum on a wire wound resistor. Wire wound resistances termed noninductive are wound to decrease inductance but this is usually only effective for very low frequencies.

3.2.5 Capacitance Effects

Capacitance effects in resistors are usually much less serious than inductive effects but consideration is necessary and increasingly important as frequency is increased.

3.2.6 Resistance Change with Frequency

The change of resistance with frequency due to skin effects and other causes can become very severe at frequencies above 2 MHz. Some types of resistors will have effective high frequency resistance (as low as 30 percent at 50 MHz in one case). In general, the thickness of the resistance element and value of resistance must be considered. The ratio of resistance at any frequency/dc resistance is nearest to 1 for very thin films and very low resistance values.

3.2.7 Current in Variable Resistance

The current in a variable resistance computed from allowable power is determined for the full winding and maximum resistance. The current in any portion of the winding shall not exceed the derated current determined for the full winding.

3.3 Examples

Power Rating

Maximum continuous rated watts @ 70°C ambient based on load life test

Temperature deratings

1/2W resistor

$$P = 0.5 - \frac{0.5}{80} (T - 70)$$

$$@\ T = 85°C \quad P = 0.5 - \frac{0.5}{80} (15) = 0.5 - \frac{7.5}{80} = 0.406W$$

1/4W resistor

$$P = 0.25 - \frac{0.25}{80} (t - 70)$$

$$@\ T = 85°C \quad P = 0.25 - \frac{0.25}{80} (15) = 0.25 - 0.0469$$

$$= 0.203W$$

1/8W resistor

$$P = 0.125 - \frac{0.125}{60} (T - 70)$$

$$@\ T = 85°C \quad P = 0.125 - \frac{0.125}{60} (15) = 0.125 - 0.0312$$

$$= 0.094W$$

3.3 (continued)

For 1/2W resistor derated to 85°C ambient temp.

$P_{D_{max}}$ = 0.406 watts

Flight derating to 40% yield

$P_{F_{max}}$ = 0.1624W = 162.4 mw

For 1/4W resistor

$P_{D_{max}}$ = 0.203 watts

$P_{F_{max}}$ = 81.2 mw

For 1/8W resistor

$P_{D_{max}}$ = 94 mw

$P_{F_{max}}$ = 37.6 mw

4.0 Semiconductor Derating

4.1 Derating Factors

The Semiconductor device derating factors, shown in Table 4-1, shall be applied after all deratings stated or implied by the part manufacturer have been used in the circuit design. Table 4-1 shows the maximum allowable percentage of voltage and current and the limit of junction temperature to be applied.

5.0 Power Derating

The objective of power derating is to hold the worst-case junction temperature to a value lower than the normal permissible rating. The actual temperature rise per unit of power will be considerably less, but is not a value which can be readily determined for each unit.

5.1 Junction Temperature Derating

Junction temperature derating requires the determination of ambient temperature or case temperature. The worst-case ambient temperature or case temperature for the part shall be established for the area and for the environmental conditions which will be encountered in service. The ambient temperature for a device which does not include some means for thermal connection to a mounting surface shall

Table 4-1

SEMICONDUCTOR DEVICE DERATING FACTORS

Semiconductor Type	Max. Junction Temp T_j	Voltage Deratings			Current Derate 1
		Design Max V_{max}	Continuous Peak V_{Peak}	Instant Surge V_{Surge}	
Diode, General Purpose	Silicon, 100°C	60%	75%	90%	75%
Diode, Switching, Low Power	Silicon, 100°C	60%	75%	90%	75%
Diode, Switching, Power	Silicon, 100°C	60%	75%	90%	75%
Diode, Rectifier, Low Power	Silicon, 100°C	60%	75%	90%	75%
Diode, Rectifier, Power	Silicon, 100°C	60%	75%	90%	75%
Diode, Regulator, Low Power	Silicon, 100°C	Reverse Voltage Cannot be Derated			75%
Diode, Regulator Power	Silicon, 100°C	Reverse Voltage Cannot be Derated			75%
Diode, Voltage Reference	Silicon, 100°C	Reverse Voltage and Current Cannot be Derated			75%
Transistor, High Frequency	Silicon, 100°C	60%	75%	90%	75%
Transistor, High Freq. Power	Silicon, 100°C	60%	75%	90%	75%
Transistor, Switch, Low Power	Silicon, 100°C	60%	75%	90%	75%
Transistor, Switch, High Power	Silicon, 100°C	60%	75%	90%	75%
Transistor, Gen. Purpose	Silicon, 100°C	60%	75%	90%	75%
Transistor, Gen. Purpose, Power	Silicon, 100°C	60%	75%	90%	75%
Transistor, Field Effect, Junction	Silicon, 100°C	60%	75%	90%	75%
Integrated Circuit, Digital Logic	Silicon, 100°C	60%	75% where appl.	90%	75%
Integrated Circuit, Linear Amplifier	Silicon, 100°C	60%	75% where appl.	90%	75%

5.1 (continued)

include the temperature rise due to the device adjacent devices and any heating effect which can be encountered in service.

5.2 Thermal Resistivity to Air

The thermal resistivity to air is expressed in degrees C per watt (or milliwatt) or its reciprocal; derating factor, which is usually expressed in milliwatts per degree C.

5.3

The maximum power for devices rated to case temperature is established as follows: Devices used in spacecraft application are generally thermally connected to a heat sink, since flowing air is usually not available as a coolant. By proper power derating, the case temperature can be controlled.

The thermal resistivity, junction to case (θ_{j-c}) or the thermal derating factor, is used to determine acceptable power for a maximum junction temperature when the case temperature is controlled.

Maximum power shall be determined from the case temperature of the device measured under the most severe operating conditions. The equation to be used is:

$$P_w(max) = \frac{T_{jo} - T_c}{\theta_{j-c}}$$

where:

θ_{j-c} is the thermal resistance of the device rated to case

T_c is the measured case temperature

T_{jo} is the derated junction temperature.

5.4 Where a cooling medium is available, the above formula can be used by substituting the manufacturer's thermal resistivity rating where available for the device rated to air (θ_{j-a}) for the θ_{j-c} in the equation above. θ_{j-a} is established for the conductance of air at one foot per second velocity and at 25°C. Where the coolant differs from that conductance, the derating shall be changed to correspond.

5.4 (continued)

Continuous peak voltage is the voltage at the peak of any signal or continuous condition which is a normal part of the design conditions. A continuous peak voltage is the highest voltage which can be observed on an oscilloscope under any normal operating condition.

Design maximum voltage is the highest average voltage. This is essentially the dc voltage as read by a dc meter. The ac signals can be superimposed on the dc voltage allowing a higher peak voltage providing the continuous peak voltage is not exceeded.

6.0 Integrated Circuit Deratings

6.1 Derating Factors

The percentage power and voltage deratings of the semiconductor section are also applicable to integrated circuits where pertinent. Normally the limitations of the discrete devices have been incorporated into the design of the internal circuits and cannot be changed. The pertinent deratings for design of equipment is to select the permissible voltage swings of power supply and the input signal to 60 percent of the acceptable limits of the manufacturer's data sheet as shown below:

6.2 Precautions

Power supply voltage derating shall be determined as follows:

$$\text{Derated Minimum Voltage } (V_{MIN}(d)) = V_{NOM} - 0.6\ (V_{NOM} - V_{MIN})$$

$$\text{Derated Maximum Voltage } (V_{MAX}\ (d)) = V_{NOM} + 0.6\ (V_{MAX} - V_{NOM})$$

where V_{NOM} = Manufacturer's rated nominal voltage

V_{MAX} = Manufacturer's rated maximum voltage

V_{MIN} = Manufacturer's rated minimum voltage.

Fan in and fan out loading shall be held to 75% of manufacturer's rated load.

6.2 Voltage Derating

The voltage rating of a device can vary with temperature, frequency or bias condition. The rated voltage implied by the tabulated ratings is the voltage compensated for all factors determined from the manufacturer's data sheet. The reliability derating consists of the application of a percentage figure to the voltage determined from all factors of the rating. Three separate deratings are given to cover the conditions which can be experienced in any design situation.

Instantaneous Peak Voltage Derating - This derating is the most important and least understood derating, and is required to protect the device against the high voltage transient spike of voltages which can occur on power lines, as a result of magnetic energy stored in inductors, transformers or relay coils. Transient spikes also can result from momentary unstable conditions which cause high amplitude oscillation during switching turnon or turnoff.

Transient spike or oscillating conditions in test sets, life test racks or due to the discharge of leakage or static electricity will cause minute breakdown of surfaces or the bulk of the semiconductor. The minute breakdown may not cause failure but can cause a substantial increase in the probability of failure during service.

Lightning transients which enter a circuit along power lines or couple from conducting structural members are a frequent cause of failure or damage which increases the probability of failure during service.

7.0 Capacitor Deratings

7.1 Use of Table 7-1

The capacitor derating factors, shown in Table 7-1, shall be applied after all deratings, stated or implied by the part manufacturer, have been used in the circuit design, The table shows the maximum allowable percentage of voltage and current to be applied to the conventionally derated condition for use in manned spaceflight applications.

7.2 Precautions

7.2.1 Do not exceed the current rating of any capacitor, taking into account the duty cycle. Provide series resistance in charge/discharge circuits. In particular, solid tantalum types shall have an effective series impedance of at least 3 ohms/volt.

7.2.2 Include dc, superimposed peak ac, peak pulse and peak transients when calculating the voltage impressed on capacitors.

7.2.3 The manufacturer's recommendation for frequency, ripple voltage, temperature, etc., shall also be followed for further derating.

Table 7-1

TABULATED DERATINGS FOR CAPACITORS

Capacitor Type	Maximum Permissible Percentage of Manufacturer's Stress Rating			
	Applicable Note	Maximum DCWV	Voltage	Current
Fixed: Ceramic	1	100-200	70	70
Electrolytic Tantalum Foil (Non-Solid) Non-polarized	3	6-150	70	70
Polarized	2&3	6-150	70	70
Electrolytic (Solid)	For polarized and non-polarized.	up to 35	70	70
Non-polarized	3	Above 50 to 75	65	70
Polarized	2&3	Above 50 to 75	60	70
Plastic or Paper Plastic	1		90	70
Glass & Vitreous Enamel	1		90	70
Mica	1		90	70
Variable: Air		250-1000	30	70
Ceramic		200-500	50	70
Glass		500-1250	50	70

NOTES:

1. The specified working voltage of a capacitor is the maximum voltage which can be applied for any period of time without a risk of damage or destruction of the dielectric.

2. Signal or ripple voltages on a capacitor can cause damage to a polarized capacitor by impressing a very short duration reverse voltage on the dielectric. Unintentional oscillation can be a cause of occasional overload on a capacitor.

Table 7-1 (continued)

3. Circuit designs must include series protection to limit the surge current to within the derated current limit under any combination of voltage which can be encountered from ripple, continuous signal, momentary transient or unstable conditions.

8.0 Transformers, Coils and Chokes Derating

The ratings and deratings of transformers, chokes and coils are covered in the following paragraphs. Transformers are frequently designed for a particular application and often become a major source of heating of other components. Two major considerations result: derating of transformers must include consideration of their heating of other components, and transformers are seldom rated by power, and derating requires control of ambient plus winding temperature rise to insure a maximum winding temperature.

8.1 Derating Voltage

8.1.1 Winding Voltages

Winding voltages are fixed voltages and cannot be derated to any significant degree as a means of improving reliability. The small changes in output voltages due to factors other than turns ratio is included in the expansion factors in Table 8-1.

8.1.2 Voltages Between Windings or Windings and Case

The voltages present between any two windings, between any winding and case or between any winding and shield as specified, shall be derated in accordance with the voltage derating factors of Table 8-1.

8.2 Power Derating

The power dissipated in a transformer shall be derated to control the winding temperature to the maximum derated temperature under full load conditions which are normal to the worst case service conditions.

Temperature rise shall be determined for service conditions by measurement of winding resistance using the procedure of MIL-T-27B, Section 4.8.10.

The total power in any transformer shall be controlled to provide the derated temperature independent of the maximum allowable current in any individual winding after derating. Restated, this means that the total temperature rise cannot be exceeded, though the total derated currents and voltages would indicate a higher derated power.

8.2 (continued)

The insulation grade of a transformer is rated for maximum operating temperatures. The transformer grade normally includes the maximum operating temperature rating. Deratings shown by Table 8-1 are allowances of temperature to be subtracted from the maximum rated temperature to determine derated temperature. All considerations of frequency, or other factors included in the manufacturers data shall be allowed prior to the application of this reliability derating temperature.

8.3 Derating Current

The maximum current in each winding shall be derated in accordance with the percentage deratings shown in Table 8-1. The derated current shall be considered as the largest current which can flow in the winding under any combination of operating conditions.

Inrush transient currents shall be limited to the maximum allowable inrush or surge rating of the transformer as shown in Table 8-1.

The current in all windings combined shall not cause a combined excess of power dissipation or temperature in excess of derated temperature.

Table 8-1

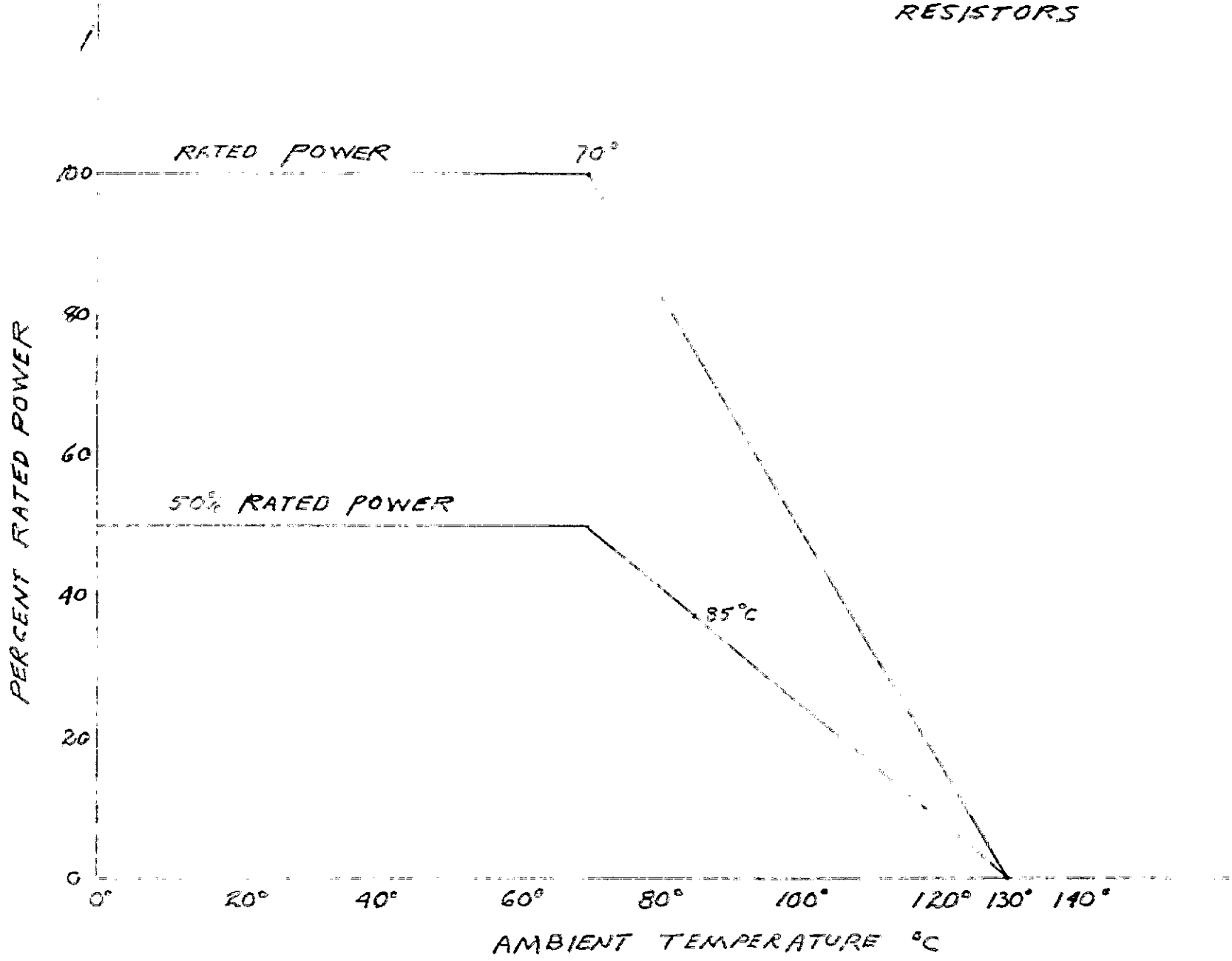
TABULATED DERATINGS FOR
TRANSFORMERS, COILS AND CHOKES

Type of Coil or Transformer	Note Applicable Section	Max. Permissible Percent of Mfg's Stress Rating			Winding Temperature Rated Temp. Less
		Voltage		Current	
		Maximum	Transient	Operating	
Coil, Inductor Saturable Reactor	8.1-8.3	60%	90%	60%	30°C
Coil, Radio Frequency, Fixed	8.1-8.3	60%	90%	70%	30°C
Inductor, Gen.	8.1-8.3	60%	90%	70%	30°C
Transformer, Audio	8.1-8.3	60%	90%	70%	30°C
Transformer Pulse Low Power	8.1-8.3	60%	90%	70%	30°C
Transformer, Power	8.1-8.3	60%	90%	70%	30°C
Transformer, Radio Frequency	8.1-8.3	60%	90%	70%	30°C
Transformer, Saturable Core	8.1-8.3	60%	90%	60%	30°C

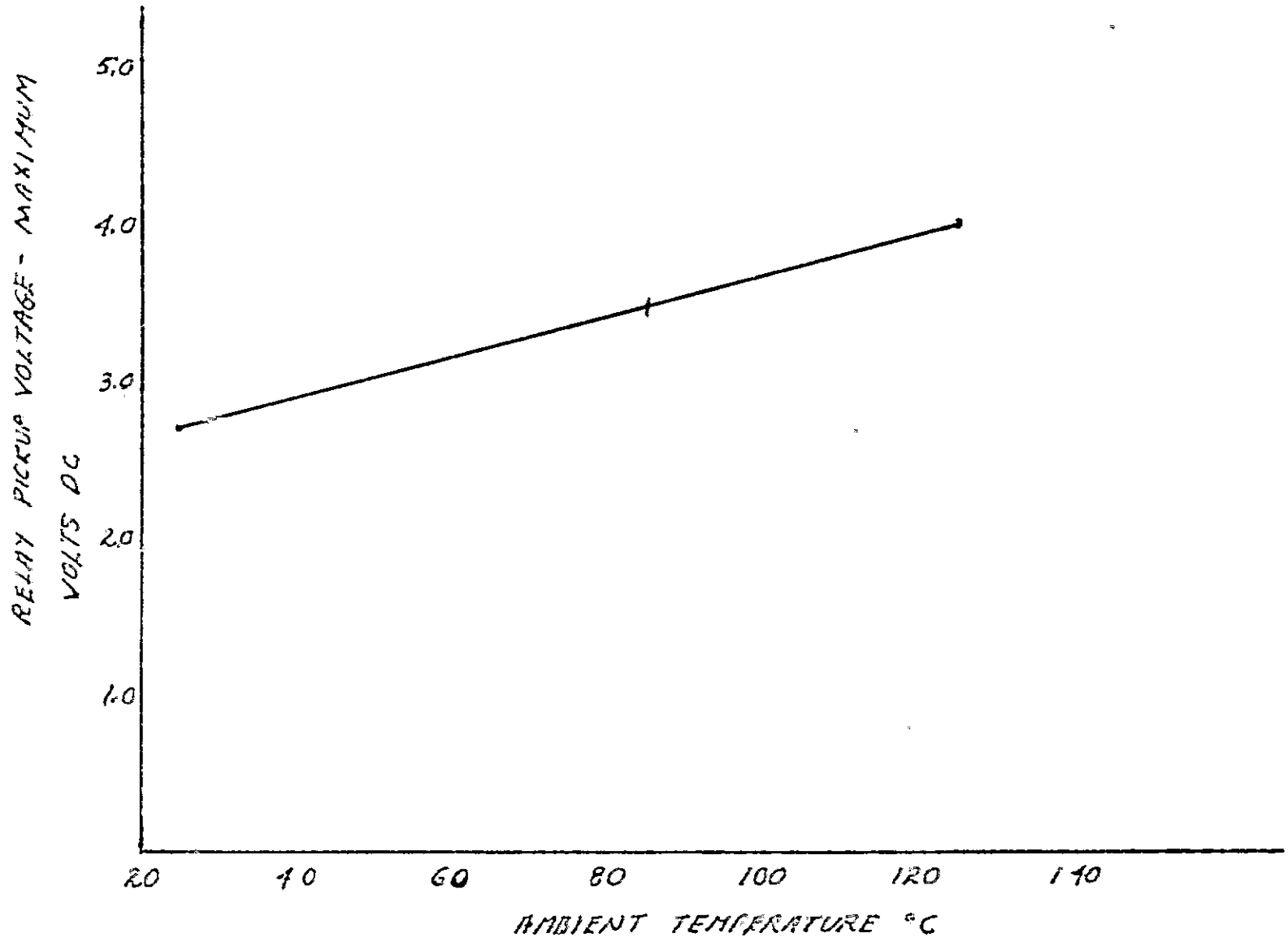
EXAMPLES OF

SEMICONDUCTOR CHARTS

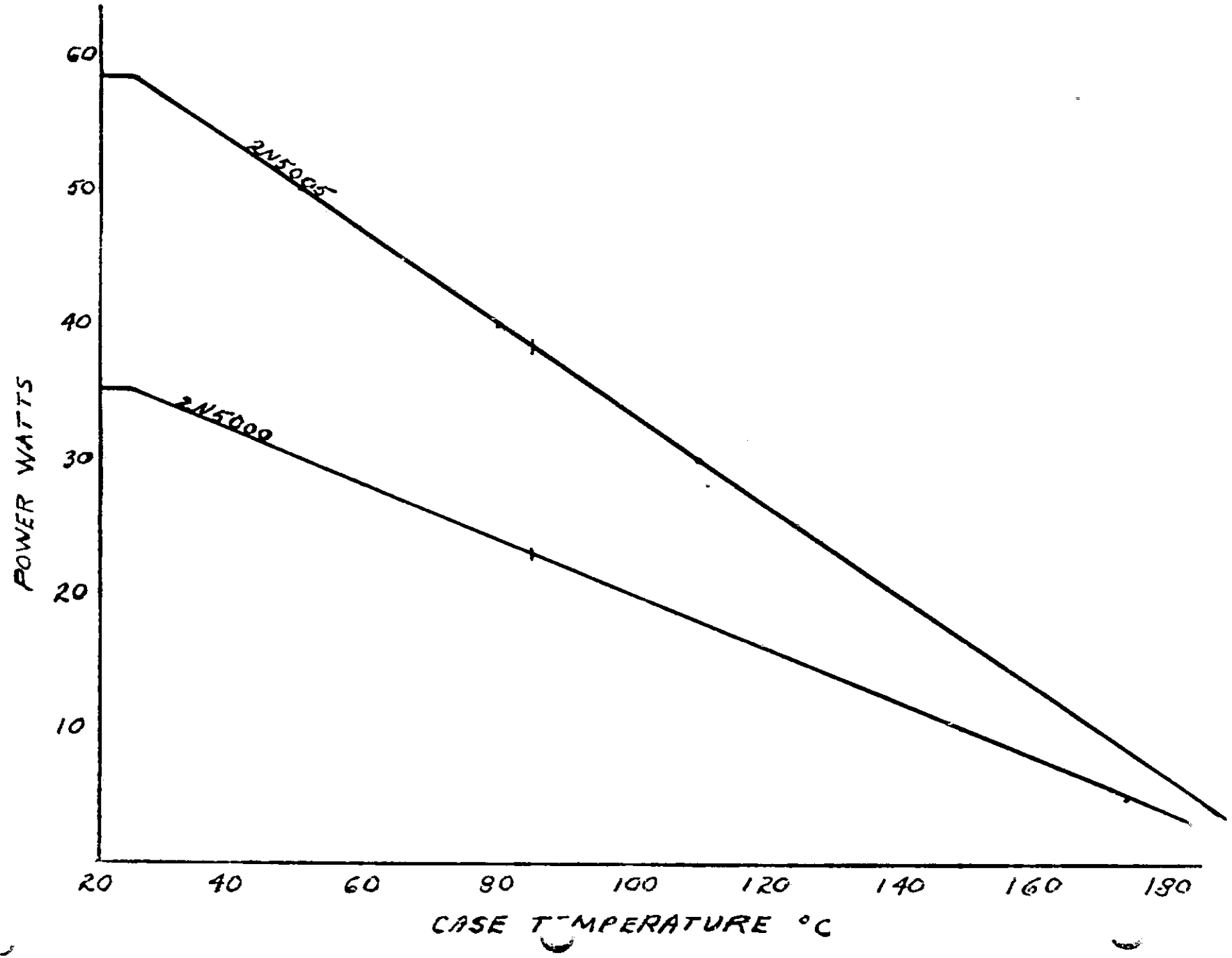
POWER DERATING CURVE
RCR07 AND RCR20
CARBON COMPOSITION
RESISTORS



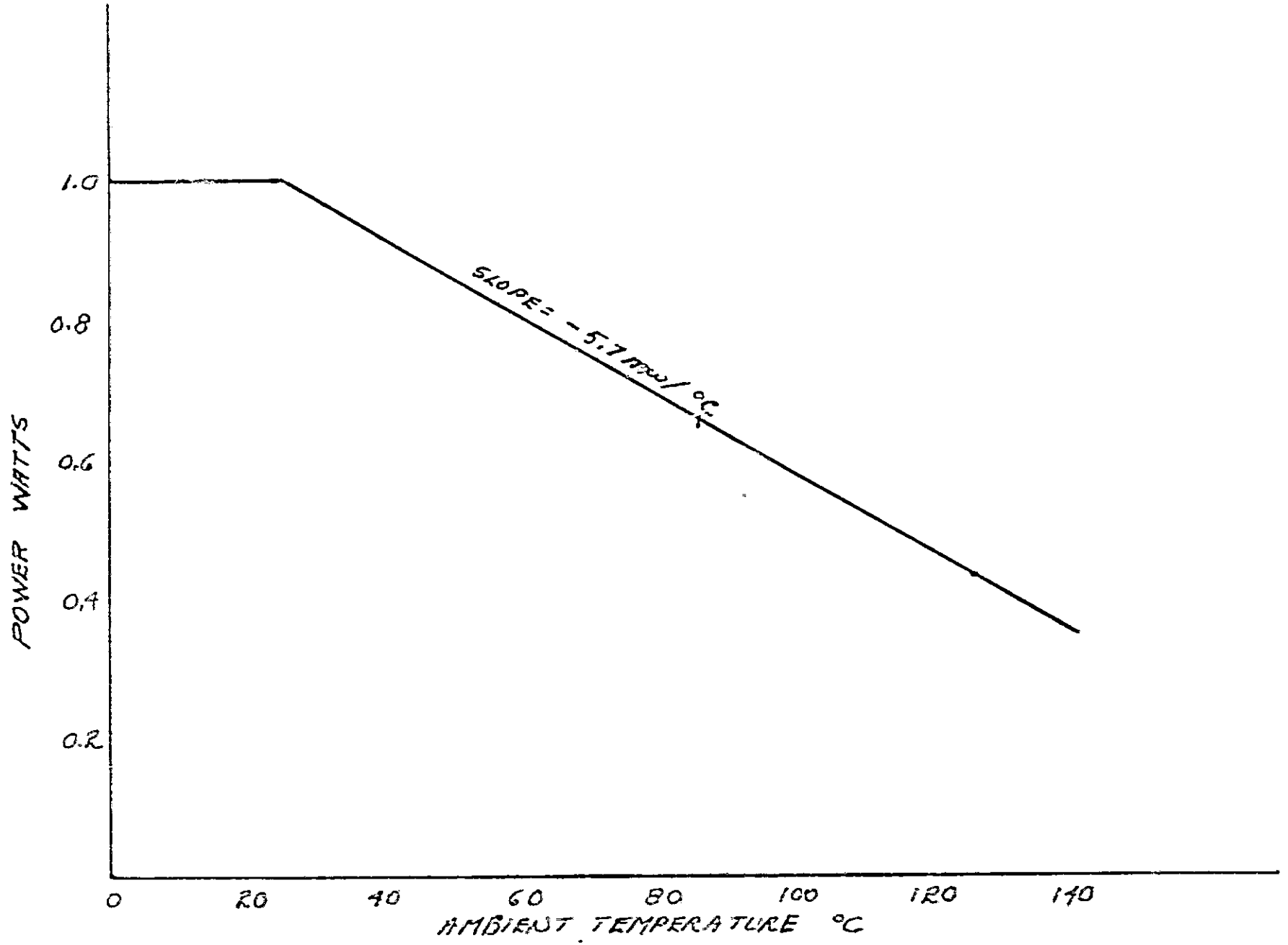
35BC5004B1 RELAY
PARAMETER DERATING



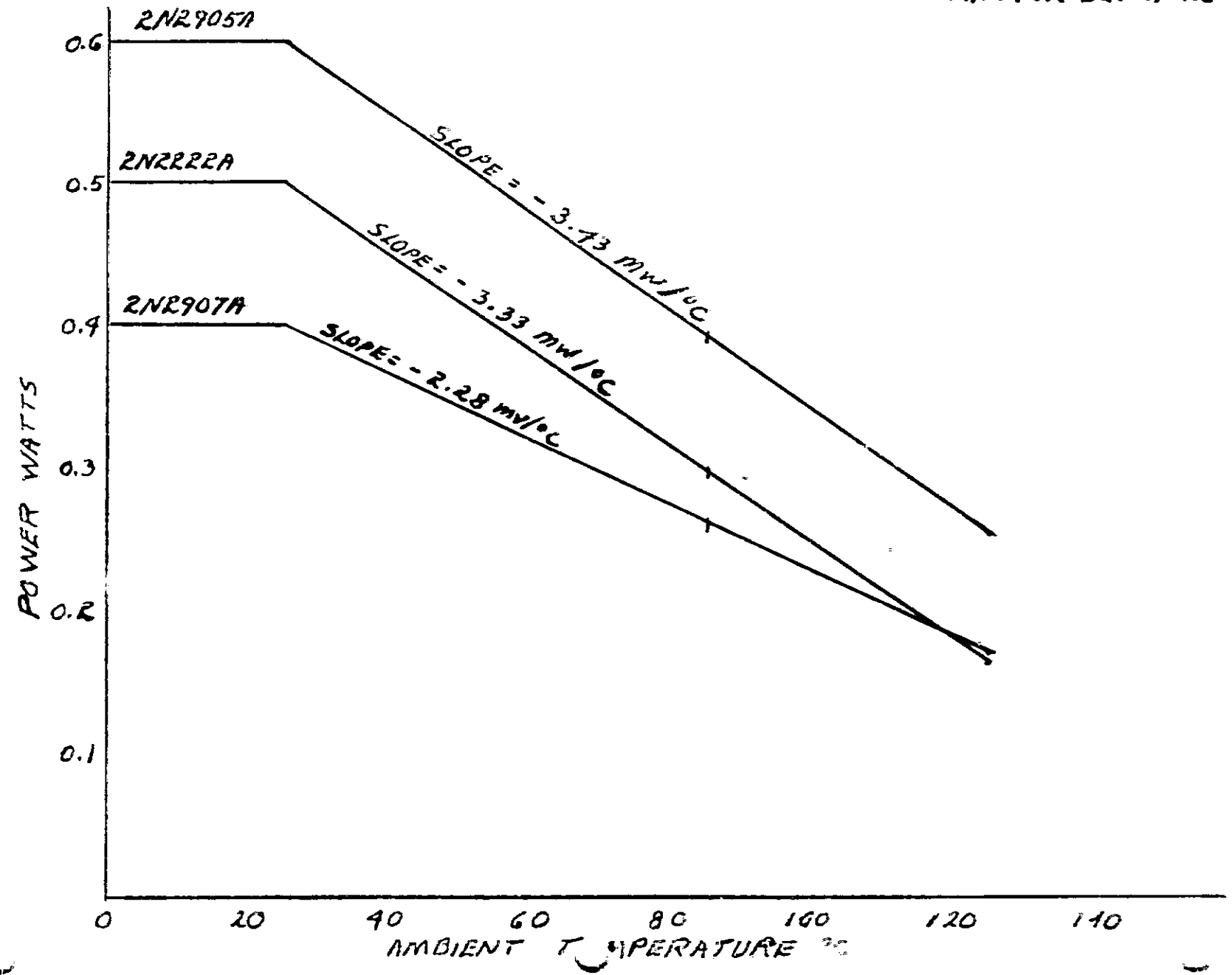
2N5005, 2N5000 TRANSISTORS
PARAMETER DERATING



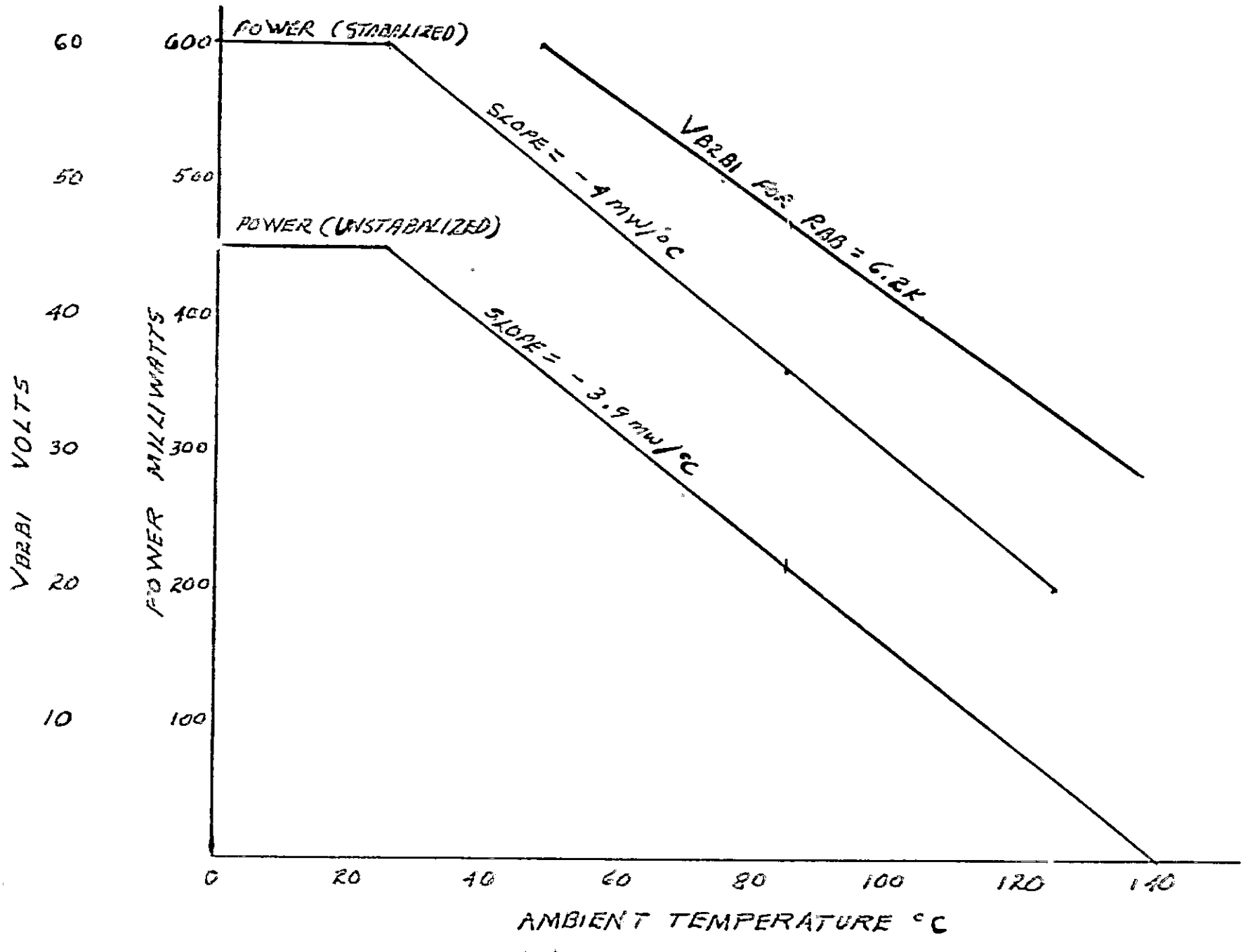
2N3252 TRANSISTOR
PARAMETER DERATING

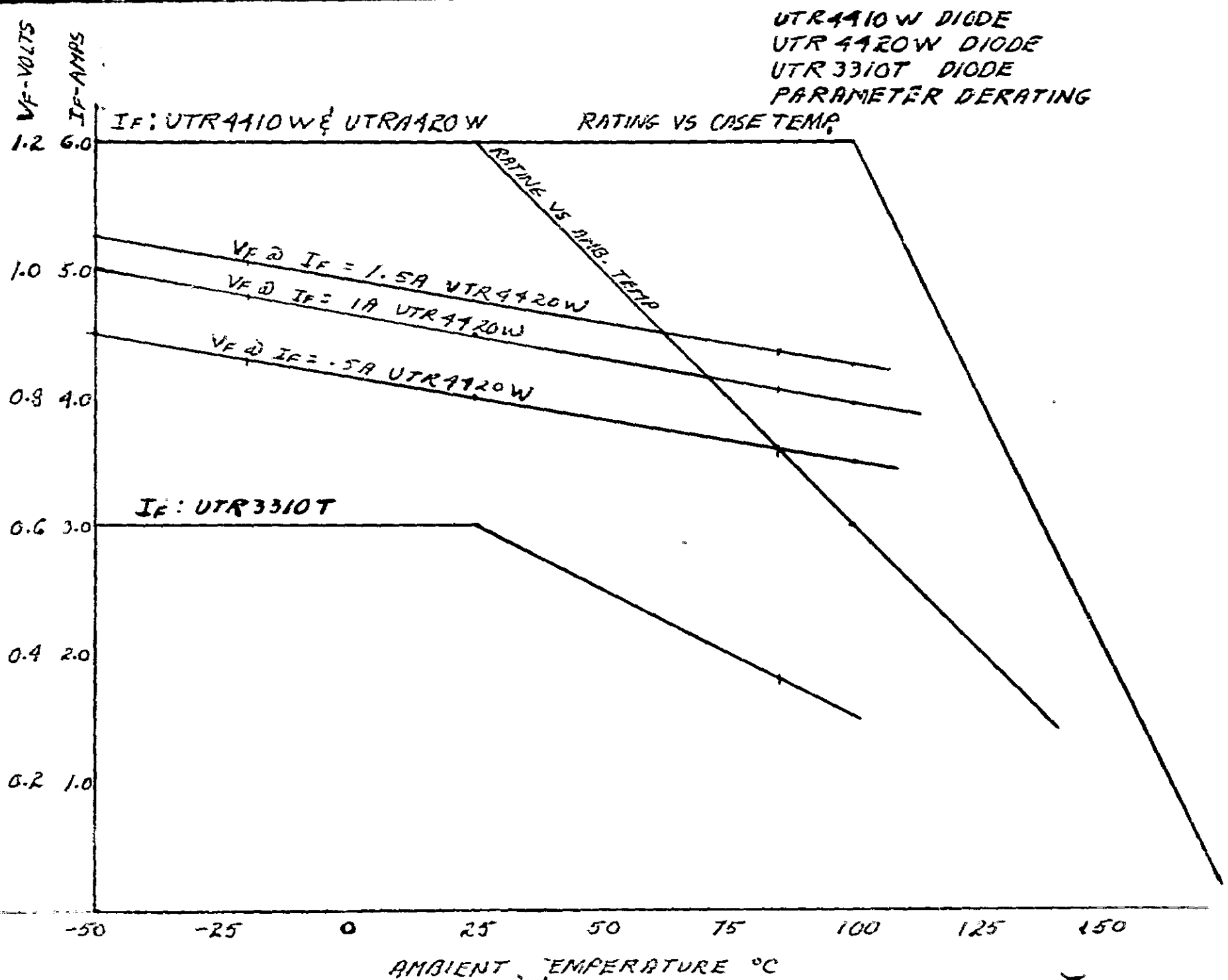


JAN TX 2N2905A, JANTX2N2907A
JAN TX 2N2222A
PARAMETER DERATING

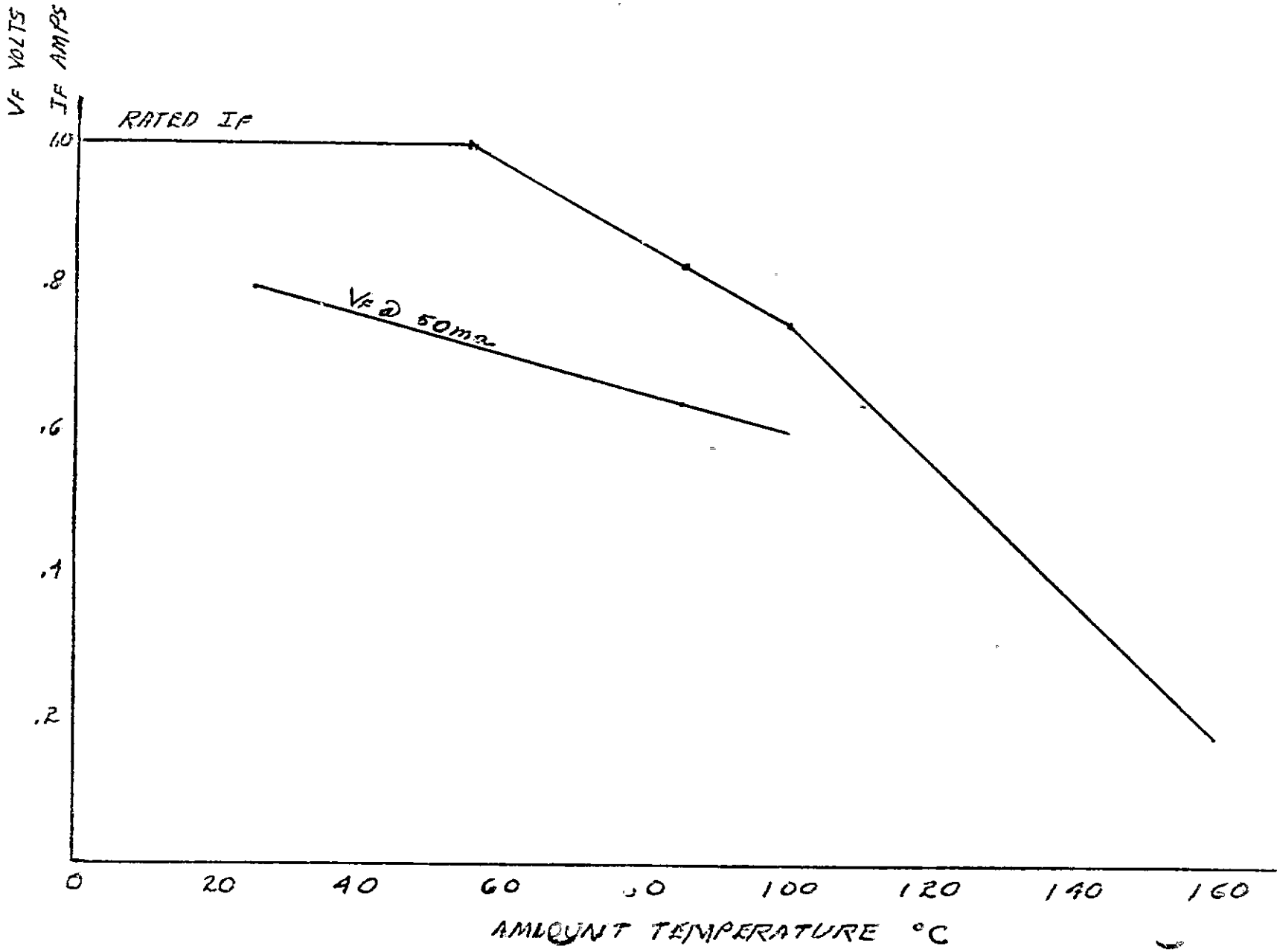


JANTX 2N494A
UNIJUNCTION TRANSISTOR
PARAMETER DERATING

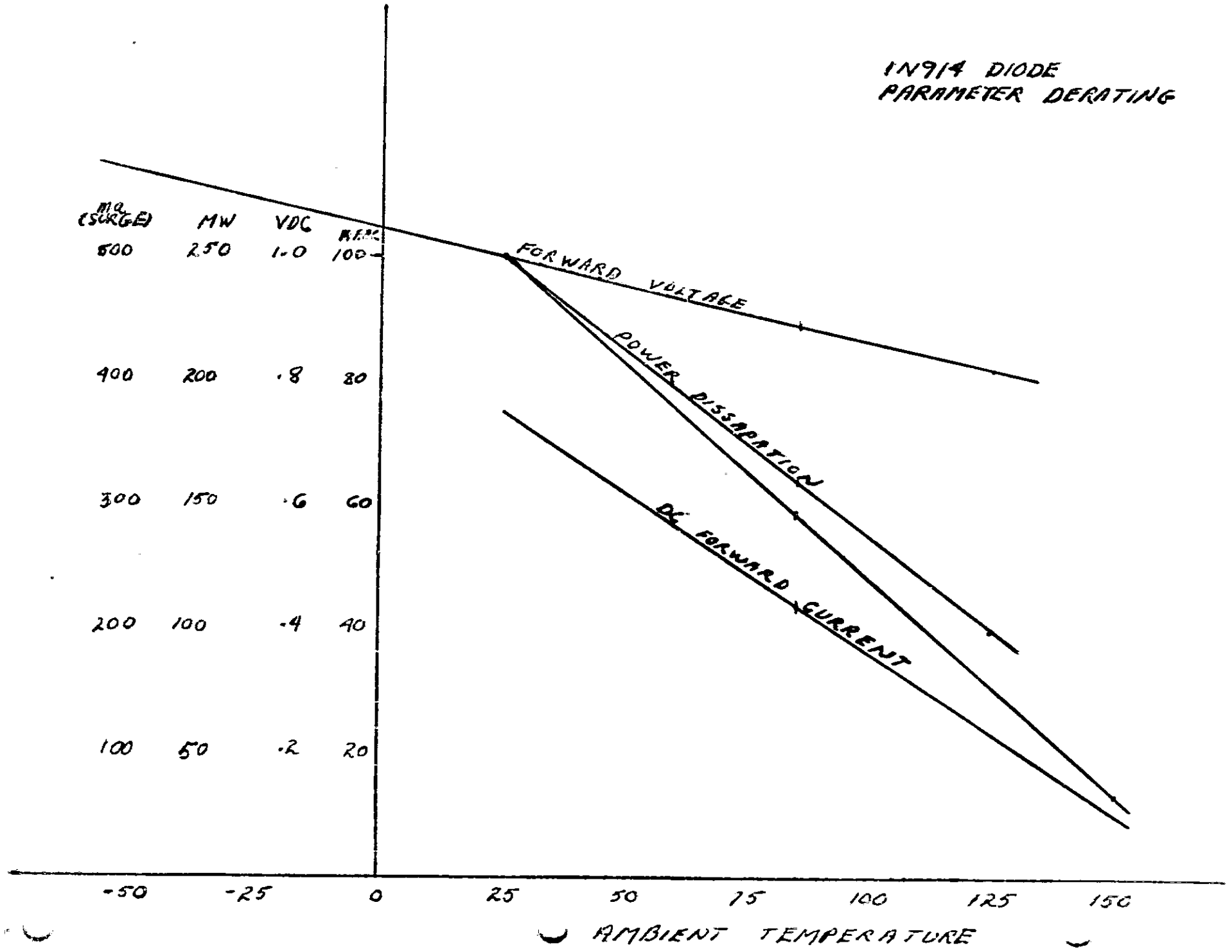



UTR4410W DIODE
UTR4420W DIODE
UTR3310T DIODE
PARAMETER DERATING
VF-VOLTS
IF-AMPS
IF: UTR4410W & UTR4420W
RATING VS CASE TEMP.
RATING VS AMB. TEMP.
VF @ IF = 1.5A UTR4420W
VF @ IF = 1A UTR4420W
VF @ IF = .5A UTR4420W
IF: UTR3310T
1.2 6.0
1.0 5.0
0.8 4.0
0.6 3.0
0.4 2.0
0.2 1.0
-50 -25 0 25 50 75 100 125 150
AMBIENT TEMPERATURE °C

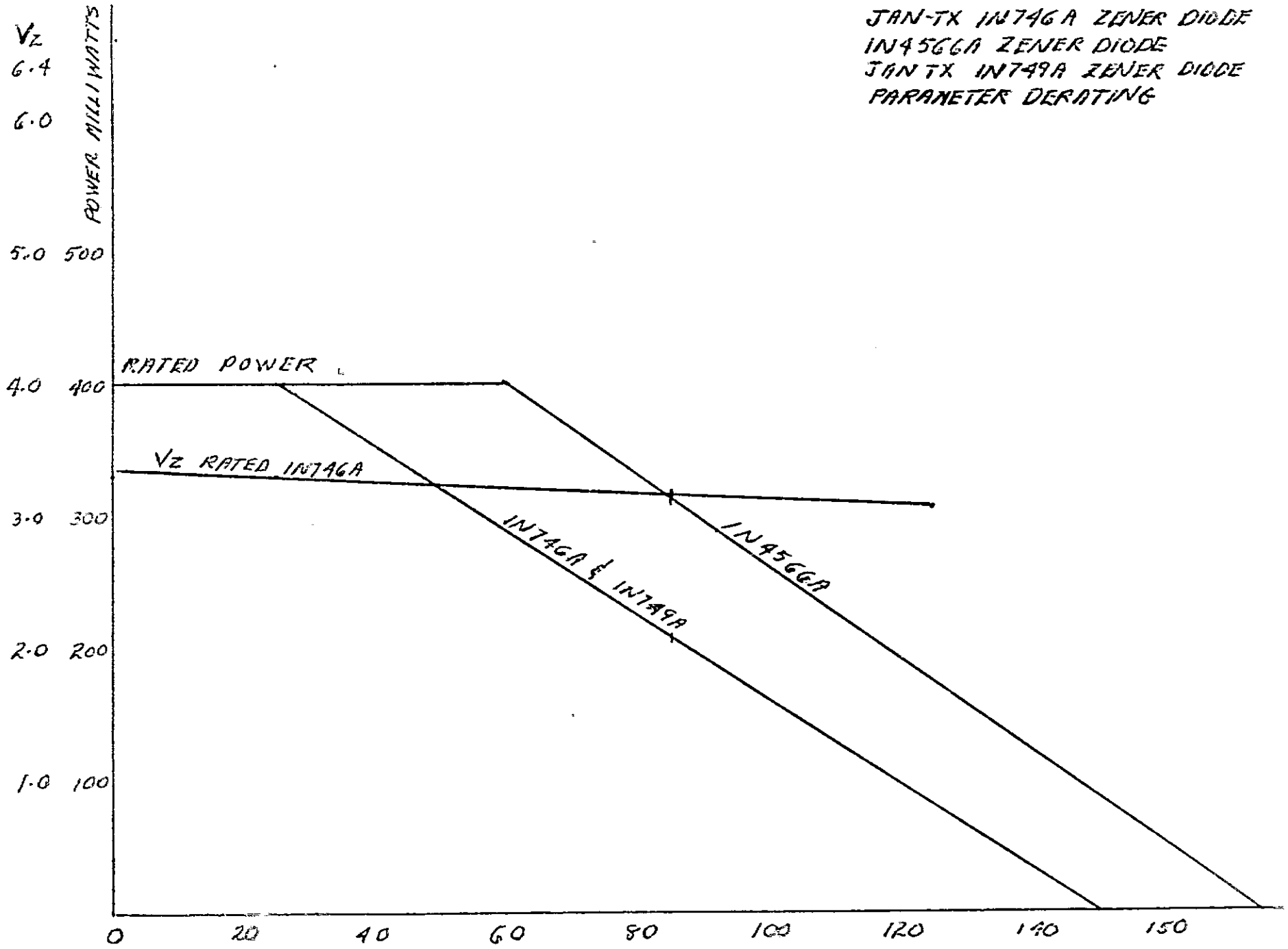
JAN TX-1N4942 & 1N4942U
PARAMETER DERATING



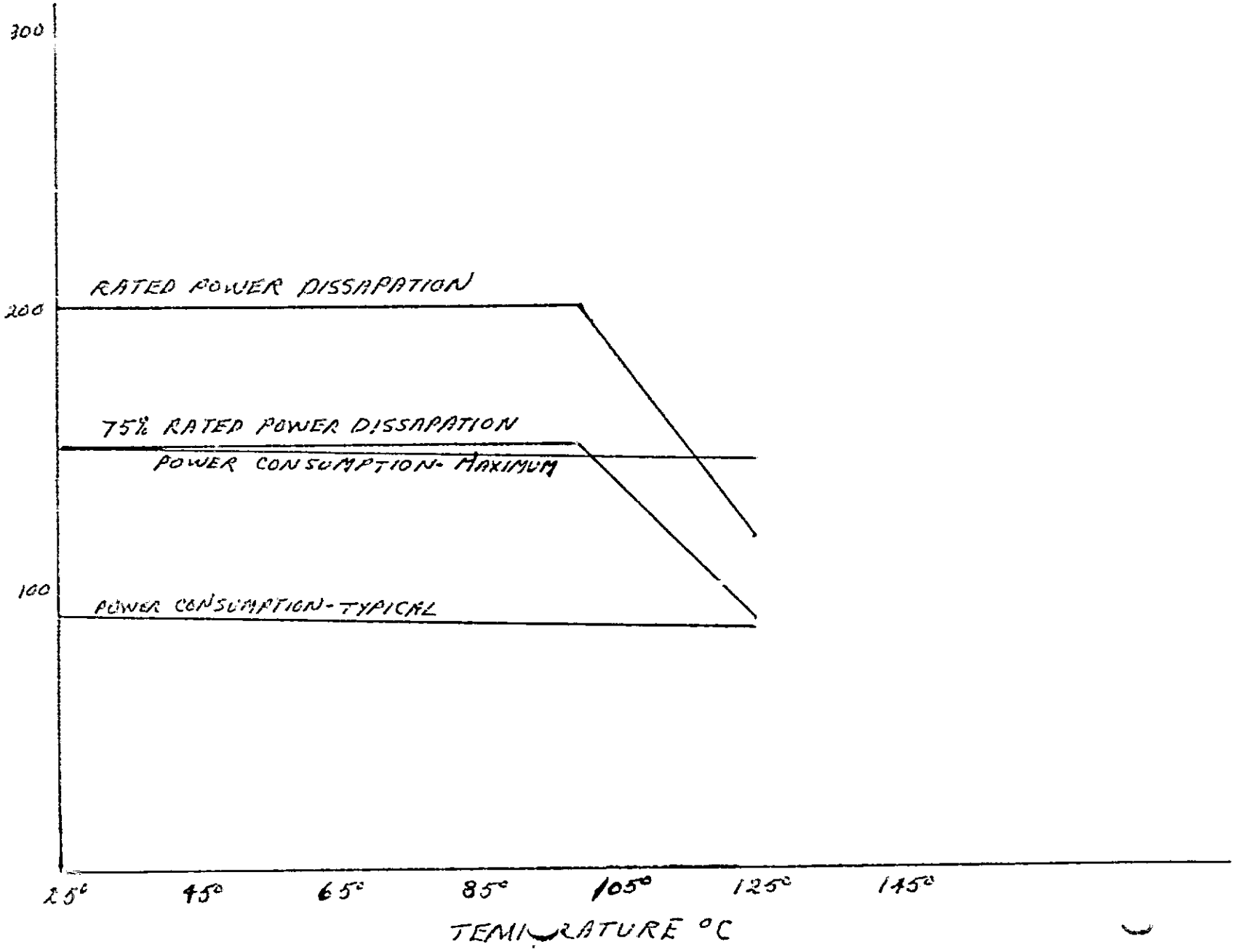
1N914 DIODE PARAMETER DERATING



JAN-TX 1N746A ZENER DIODE
1N456GA ZENER DIODE
JAN TX 1N749A ZENER DIODE
PARAMETER DERATING



U3F77103IX COMPARATOR
POWER DISSAPATION
DERATING
V_S = +12VDC AND -6VDC



U3F770931X OP AMP
POWER DISSAPATION
DERATING

$V_S = \pm 15$ VDC